

DAHOMY NATIONAL WILDLIFE REFUGE

HABITAT MANAGEMENT PLAN



Photo: B. Rosamond



**U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region**

September 2013

Dahomey National Wildlife Refuge

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Reviewed by:

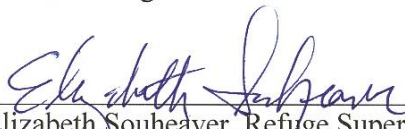
for 

Chuck Hunter, Chief
Division of Planning and Resource Management
Southeast Region

11/12/2013

Date

Concurred by:

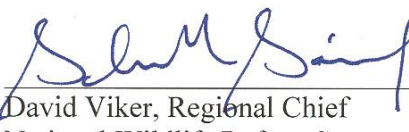


Elizabeth Souheaver, Refuge Supervisor
Southeast Region, Area II

11/14/13

Date

Approved by:



David Viker, Regional Chief
National Wildlife Refuge System
Southeast Region

12/4/13

Date

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Planning Process	1
1.2	Refuge Purposes	2
1.3	Refuge Vision.....	3
1.4	Relationship to Other Plans	3
2.0	ENVIRONMENTAL SETTING AND BACKGROUND	6
2.1	Location	6
2.2	Management Units	6
2.3	Physical Features	10
2.3.1	<i>Climate</i>	10
2.3.2	<i>Topography and Hydrology</i>	10
2.3.3	<i>Soils</i>	12
2.3.4	<i>Geomorphology</i>	13
2.4	History of Refuge Lands.....	15
2.4.1	<i>Cultural and Refuge Land History</i>	15
2.4.2	<i>Pre-European Habitat Conditions</i>	16
2.4.3	<i>Current Habitat Condition and Types</i>	17
2.4.3.1	<i>Fallow Fields</i>	17
2.4.3.2	<i>Agricultural/Moist Soil Units</i>	17
2.4.3.3	<i>Aquatic Habitats</i>	18
2.4.3.4	<i>Bottomland Hardwood</i>	19
2.4.3.5	<i>Reforested Bottomland Hardwood</i>	22
2.4.4	<i>Invasive Species</i>	23
2.4.5	<i>Habitat Changes from Historic to Current Conditions</i>	23
3.0	REFUGE RESOURCES OF CONCERN.....	27
3.1	Identification of Refuge Resources of Concern.....	27
3.1.1	<i>Migrating and Wintering Waterfowl</i>	28
3.1.2	<i>Breeding Wood Ducks</i>	28
3.1.3	<i>Forest Interior Birds of Bottomland Hardwoods</i>	28
3.1.4	<i>Rafinesque's Big-eared Bat and Southeastern Myotis</i>	30
3.1.5	<i>Black Bear</i>	30
3.1.6	<i>Pondberry</i>	30
3.2	Habitat Requirements of Resources of Concern.....	32
3.2.1	<i>Migrating and Wintering Waterfowl</i>	32
3.2.2	<i>Breeding Wood Ducks</i>	33
3.2.3	<i>Forest Interior birds of Bottomland Hardwoods</i>	33
3.2.4	<i>Rafinesque's Big-eared Bat and Southeastern Myotis</i>	35
3.2.5	<i>Black Bear</i>	36
3.2.6	<i>Pondberry</i>	37
4.0	HABITAT MANAGEMENT GOALS and OBJECTIVES	38
4.1	Habitat Management Goals and Objectives.....	38
	<i>Objective 4.1.1</i>	38

Objective 4.1.2	39
Objective 4.1.3	40
Objective 4.1.4	40
Objective 4.1.5	42
Objective 4.1.6	43
4.2 Land Acquisition Goal	44
Objective 4.2.1	44
5.0 HABITAT MANAGEMENT STRATEGIES	45
5.1 Moist-Soil Management Strategies	45
5.1.1 <i>Potential Strategies</i>	45
5.1.2 <i>Management Strategy Prescription for Agricultural/Moist</i>	46
5.2 Green-tree Reservoir Management Strategies	47
5.2.1 <i>Potential Strategies</i>	47
5.2.2 <i>Management Strategy Prescription for Green-tree Reservoir</i>	48
5.3 Forest Wetland Protection and Restoration Mgt. Strategies	48
5.3.1 <i>Potential Strategies</i>	48
5.3.2 <i>Management Strategy Prescription for Forest Wetland Protection & Restoration</i>	49
5.4 Bottomland Hardwood Forest Management Strategies	49
5.4.1 <i>Potential Strategies</i>	49
5.4.2 <i>Management Strategy Prescription for Mature Hardwood Forest</i>	50
5.5 Hardwood Reforestation Management Strategies	51
5.5.1 <i>Potential Strategies</i>	51
5.5.2 <i>Management Strategy Prescription for Hardwood Reforestation</i>	51
5.6 Breeding Wood Duck Management Strategies	52
5.6.1 <i>Potential Strategies</i>	52
5.6.2 <i>Management Strategy Prescription for Breeding Wood Ducks</i>	53
5.7 Pondberry Management Strategies	53
5.7.1 <i>Potential Strategies</i>	53
5.7.2 <i>Management Strategy Prescription for Pondberry</i>	53
5.8 Land Acquisition and Management Strategy	54
5.8.1 <i>Potential Strategies</i>	54
5.8.2 <i>Management Strategy Prescription for Land Acquisition</i>	54
5.9 Wild Pig Management Strategies	55
5.9.1 <i>Potential Strategies</i>	55
5.9.2 <i>Management Strategy Prescription for Wild Pig</i>	55
6.0 RESOLVING RESOURCE OF CONCERN CONFLICTS	56
7.0 LITERATURE CITED	58
8.0 APPENDIX A: SCIENTIFIC AND COMMON NAMES	63
9.0 APPENDIX B: ENVIRONMENTAL ACTION STATEMENT	65

LIST OF FIGURES

Figure 1. Location of Dahomey National Wildlife Refuge	7
Figure 2. Forty-eight Management Units of Dahomey NWR	8
Figure 3. Forest Compartment Management Units of Dahomey NWR	9
Figure 4. Soil Associations found on Dahomey NWR	14

LIST OF TABLES

Table 1. Habitat Management Units	11
Table 2. Management Capability of Agricultural/Moist-soil Units	18
Table 3. Acres of Cooperative Farming and Reforestation	26

I. INTRODUCTION

The complexity of the National Wildlife Refuge System and the individual refuges which comprise the system represent some of the most important areas for the conservation of native flora and fauna within North America. National Wildlife Refuges are designed to protect and enhance the trust wildlife resources (i.e., migratory birds, endangered and threatened species, and inter-jurisdictional fish) and equally important the habitats on which these trust species are dependent.

The development of Comprehensive Conservation Plans for each refuge or complex has provided guidance on habitat management. However, these broad documents lack sufficient detail to implement on-the-ground actions to fulfill the plans. The refinement to manage, enhance, restore, and protect trust resources and their habitats has been undertaken through Habitat Management Plans which rely on the best available scientific information and flexibility to change (i.e. Adaptive Management) based on new information or unanticipated results.

Planning Process

Habitat Management Plans (HMP) are dynamic working documents that provide refuge managers a decision-making process; guidance for the management of refuge habitat; and establishes long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan incorporates the establishing purpose of the refuge and the associated habitats in international, national, regional, tribal, State, ecosystem and refuge goals and objectives. Furthermore, the HMP planning process guides analysis and selection of specific habitat management strategies to achieve specific habitat and resources of concern goals and objectives by utilizing refuge level inventory and monitoring data, scientific literature, expert opinion, and staff expertise.

The statutory authority for conducting habitat management planning on National Wildlife Refuges (NWR) is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge Improvement Act of 1997 (Refuge Improvement Act), 16 U.S.C. 668dd - 668ee. Section 4(a) (3) of the Refuge Improvement Act states: "With respect to the System, it is the policy of the United States that each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established ..." and Section 4(a) (4) states: "In administering the System, the Secretary shall monitor the status and trends of fish, wildlife, and plants in each refuge" . . . "ensure that the biological integrity, diversity, and environmental health of the System are maintained". The Refuge Improvement Act provides the Service the authority to establish policies, regulations, and guidelines governing habitat management planning within the System.

An HMP is a step-down management plan of the Refuge Comprehensive Conservation Plan (CCP). The CCP describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purpose(s) of the refuge; helps fulfill the mission of the System; maintains and, where appropriate,

restores the biological integrity, diversity, and environmental health of each refuge and the System; helps achieve the goals of the National Wilderness Preservation System, if appropriate; and meets other mandates. The CCP for North Mississippi Refuges Complex (Complex), which includes Dahomey NWR, was finalized in 2005.

Habitat management plans comply with all applicable laws, regulations, and policies governing the management of the National Wildlife Refuge System. The lifespan of an HMP is 15 years and parallels that of refuge CCPs. Habitat management plans are reviewed every five years utilizing peer review recommendations, as appropriate, in the HMP revision process or when initiating refuge CCPs. Annual Habitat Work Plans (AHWP) will contain specific management guidance and are prepared annually.

This HMP represents a combination of what could be done in an ideal situation tempered by what is likely to be accomplished over the next 15 years, given anticipated staffing and funding. The majority of the listed objectives and strategies require, at a minimum, maintaining the status quo in terms of staffing and funding. In several cases, an increase in staffing and funding will be required to accomplish the stated objectives.

Refuge Purposes

The purposes of a National Wildlife Refuge, as established by Congress or the Executive Branch, are the basis by which all actions on that designated public land are evaluated. Habitat management, public use, and all other programs are conducted as compatible with or required to fulfill the establishment purposes of the refuge.

The Nature Conservancy in 1990 purchased lands to establish Dahomey NWR and in 1993 transferred fee title to the U. S. Fish and Wildlife Service. The basis for establishing Dahomey NWR was to meet migrating and wintering waterfowl habitat needs within the Lower Mississippi River as a goal established in North American Waterfowl Management Plan (U.S. Fish and Wildlife Service 1986). More specifically, the Dahomey NWR Environmental Assessment and Land Protection Plan (U.S. Fish and Wildlife 1991) states the refuge was proposed "...to preserve and manage wintering habitat for mallards, pintails, blue- and green-winged teal, and wood duck (Refer to Appendix 1 for scientific names).

The federally legislated purposes are "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds, and "for the development, advancement, management, conservation, and protection of fish and wildlife resources" (Migratory Bird Conservation Act, 16 U.S.C. 715d); ...for the conservation of the wetlands of the nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions..." (Emergency Wetlands Resource Act of 1986, 16 U.S.C. 3901b).

In addition to the specific purposes that were established for each refuge, Congress passed the National Wildlife Refuge System Improvement Act in 1997. This legislation

provides clear guidance for the mission of the Refuge System and prioritizes wildlife-dependent public uses. The Act states that each Refuge will:

- Fulfill the mission of the National Wildlife Refuge System;
- Fulfill the individual purposes of each refuge;
- Consider the needs of wildlife first;
- Fulfill requirements of comprehensive conservation plans that are prepared for each unit of the Refuge System
- Maintain the biological integrity, biological diversity, and environmental health of the Refuge System; and
- Recognize that wildlife-dependent recreation activities, including hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation are legitimate and priority public uses; and allow refuge managers authority to determine compatible public uses.

Refuge Vision

The Refuge Vision for Dahomey NWR was developed from the broader vision statement for the North Mississippi Refuge Complex CCP (2005).

Based on sound science, Dahomey NWR will conserve, protect, enhance, and where possible restore the ecological integrity of a bottomland hardwood forest, wetlands, wildlife, fisheries, and other plant communities within upper portions of the Mississippi Alluvial Valley for the benefits of present and future generations of Americans.

Relationship to Other Plans

The CCP for the Complex was finalized in 2005 and includes broad goals and objectives for Refuge management over a 15-year period. The purpose of the HMP is to provide more specific guidance that will facilitate the selection of prescriptions for implementing the goals and objectives of the CCP. To maintain consistent strategies for managing wildlife and habitats on the Refuge, several other planning documents were used in the development of this plan including:

North American Waterfowl Management Plan (NAWMP)

The North American Waterfowl Management Plan (U.S. Fish and Wildlife Service 1986) contains continent-wide goals and objectives for populations of waterfowl and shorebirds. The plan led to the development of Joint Ventures for various eco-regions, and step-down goals and objectives by eco-region. The Lower Mississippi Valley Joint Venture (LMVJV) developed habitat goals for migrating and wintering waterfowl on Dahomey NWR. These habitat goals were incorporated into the Complex CCP. Consequently, much of the management occurring on Dahomey relates directly to meeting these habitat goals. Working under the direction of the NAWMP, the Lower Mississippi Joint Venture (LMVJV) strives to provide habitat for over-wintering waterfowl in the Mississippi Alluvial Valley (MAV). Based on a step-down process, the LMVJV

established habitat objectives that link continental waterfowl populations to on-the-ground habitat objectives. The habitat targets established in 1996 for the refuge were approximately 1000 acres of moist-soil and 750 acres of flooded bottomland hardwood.

Mississippi Alluvial Valley Bird Conservation Plan Physiographic Area #5

A major initiative over the last 10 years is for conservation of forest interior bird. Partners in Flight (PIF) has developed conservation plans for land birds for the different ecoregions throughout the United States, including the LMV. This plan does not have specific objectives for different agencies or public land areas, but it does set some minimum area requirements for breeding populations for many of the species of concern. Based on these requirements, the LMVJV identified Bird Conservation Areas (BCAs) throughout the Delta (Twedt et al. 1998). These areas represent the highest priority areas for forest restoration. Dahomey NWR is included in the Dahomey BCA which has a core goal of 2,000 acres. (Core area is that area that is greater than 1000 meters from any edge.) Currently, the core acreage within the Dahomey BCA is 521 acres. Although the core goal has not been met, it is achievable as new lands are acquired within the acquisition boundary. Priority species have been identified within the plan based on species decline. Within the Dahomey BCA, the high priority species are the Swainson's Warbler, Cerulean Warbler, Prothonotary Warbler, Swallow-tailed Kite, Red-headed Woodpecker, Painted Bunting, Bell's Vireo, Northern Parula, Worm-eating Warbler, Kentucky Warbler, Orchard Oriole, Yellow-billed Cuckoo, Wood Thrush, and White-eyed Vireo (Twedt et al. 1998).

Southeast United States Regional Waterbird Conservation Plan

This plan provides a framework for the conservation and management of waterbirds in the Southeast that are not covered by either the North American Waterfowl Management Plan or the U.S. Shorebird Conservation Plan (Hunter et al. 2006). Threats to waterbird populations include destruction of inland and coastal wetlands, predators, invasive species, pollutants, mortality from fisheries and industries and other disturbances. No wading bird rookeries exist on Dahomey NWR and use of wetland habitats is limited to seasonal foraging as water is removed in early spring or newly flooded in late October/November within agricultural/moist-soil units.

U.S. Shorebird Conservation Plan for the Lower Mississippi

The U.S. Shorebird Conservation Plan is a partnership effort throughout the United States to ensure that stable and self-sustaining populations of shorebird species are restored and protected (Elliot and McKnight 2000). The plan was developed by a wide range of agencies, organizations, and shorebird experts for separate regions of the country, and identifies conservation goals, critical habitat conservation needs, key research needs, and proposed education and outreach programs to increase awareness of shorebirds and the threats they face. While the refuge has limited habitat specific to shorebird conservation, indirectly,

management to support waterfowl goals for the NAWMP will benefit spring migrant shorebirds at Dahomey NWR. Moreover, the reforested sites (~ 900 acres) on the refuge were planted with a mixture of hardwood seedlings on wide row spacing during the past 10-15 years. These sites should provide structure favorable to woodcock for foraging and roosting.

Mississippi's Comprehensive Wildlife Conservation Strategy

In 2005, the Mississippi Department of Wildlife, Fisheries, and Parks developed a comprehensive plan to provide a "conservation blueprint" for agencies, organizations, industries, private landowners and academics across the state to advance sound management of all of the fish and wildlife resources. This broad based plan is a guide to effective and efficient long-term conservation of Mississippi's biological diversity. (Mississippi Museum of Natural Science 2005). This state plan has identified important wildlife species for which population declines have occurred or a significant threat to their habitat exists. These have developed as a list of Species of Greatest Conservation Need. Many of these species exist presently or historically on Dahomey NWR. In addition, the state plan has identified vegetative communities of conservation concern. The most significant contribution for the refuge is the largely continuous bottomland hardwood forest and the long-term goal to acquire, restore, and protect over 25,000 acres of land linking the refuge to the hardwood forests within the mainline levee. The state plan has identified the bottomland hardwood system of the MAV as critically imperiled.

Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative

Landscape conservation cooperatives (LCC) are public-private partnerships that recognize these challenges transcend political and jurisdictional boundaries and require a more networked approach to conservation—holistic, collaborative, adaptive and grounded in science to ensure the sustainability of America's land, water, wildlife and cultural resources. The Gulf Coastal Plain and Ozark LCC encompasses the Delta region and builds on a multitude of other initiatives to achieve common conservation goals; broader in scope than avian conservation driven efforts of the Joint Ventures. Many of the identified Resources of Concern are also identified within the Gulf Coast LCC.

Other Planning Documents

Other plans reviewed during development of the HMP included recovery plans for the threatened Louisiana Black Bear (USFWS 1995) and endangered Pondberry (USFWS 1993). At present the refuge is not known to have either species but could provide habitat to support recovery actions. Recommendations from the biological review and pulse check of Dahomey NWR concerning the CCP (U.S. Fish and Wildlife Service 2003, 2011) and the most recent Forest Inventory (Smith and Sansing 2008) as well as the Lower Mississippi Valley Joint Venture Forest Resource Conservation Working

Group's report on bottomland hardwood forest management recommendations for wildlife (LMVJV 2007) were evaluated during development of the HMP.

II. ENVIRONMENTAL SETTING AND BACKGROUND

Location

Dahomey NWR is located in northwestern Mississippi within the Delta region and is centrally located in Bolivar County. The western edge of the refuge is approximately 3 miles from the Mississippi mainline levee. The levee system approximates the state line boundaries of Mississippi and Arkansas. The eastern edge approaches Bogue Phalia River. The refuge is bisected by State Road 446 with the northern and southern borders residing 2-3 miles off this road. The refuge is approximately 10 miles west, southwest of Cleveland, and approximately nine miles west of Boyle, on Mississippi Highway 446 (Figure 1). The refuge is administered by the North Mississippi Refuge Complex.

The refuge currently consists of 9,431 acres held in fee title. An additional 260-acre tract of a 16th Section is under an annual lease from the Bolivar School Board, though the refuge does not have habitat management authority on the property. With approximately 8,100 acres of mature forested land, the refuge contains the largest contiguous bottomland hardwood forest in northwest Mississippi outside of the mainline levee.

The approved acquisition boundary is 11,641 acres. A proposal to expand the refuge acquisition boundary to approximately 46,000 acres which would include all lands west to the Mississippi River and act as a linkage to White River NWR has been submitted to Washington, D.C. for approval. Nearly all the acquisition property outside the mainline levee is in agricultural while those lands within the batture (i.e., area of land between the Mississippi River and the mainline levee) are primarily mature bottomland hardwood forest and other associated wetlands.

Management Units

The refuge is divided into 48 habitat management units. These are based on habitat classification, proximity of units to each other, and logistics (keeping units at a manageable size for the habitat type, splitting fields divided by drainage ditches or other definable borders (Figure 2, Table 1). Habitat types include: agricultural/moist-soil, fallow fields, reforestation areas (< 20 year old bottomland hardwood stands), mature bottomland hardwood forest, permanent wetland habitat (bayous, sloughs, ponds/lakes, and ditches) and open right-of-ways. In addition, the refuge has identified 13 forested areas as compartments for administrative purposes of forest inventory and monitoring which overlay the base 48 habitat units (Figure 3).

Figure 1. Location of Dahomey National Wildlife Refuge in Bolivar County, Mississippi.

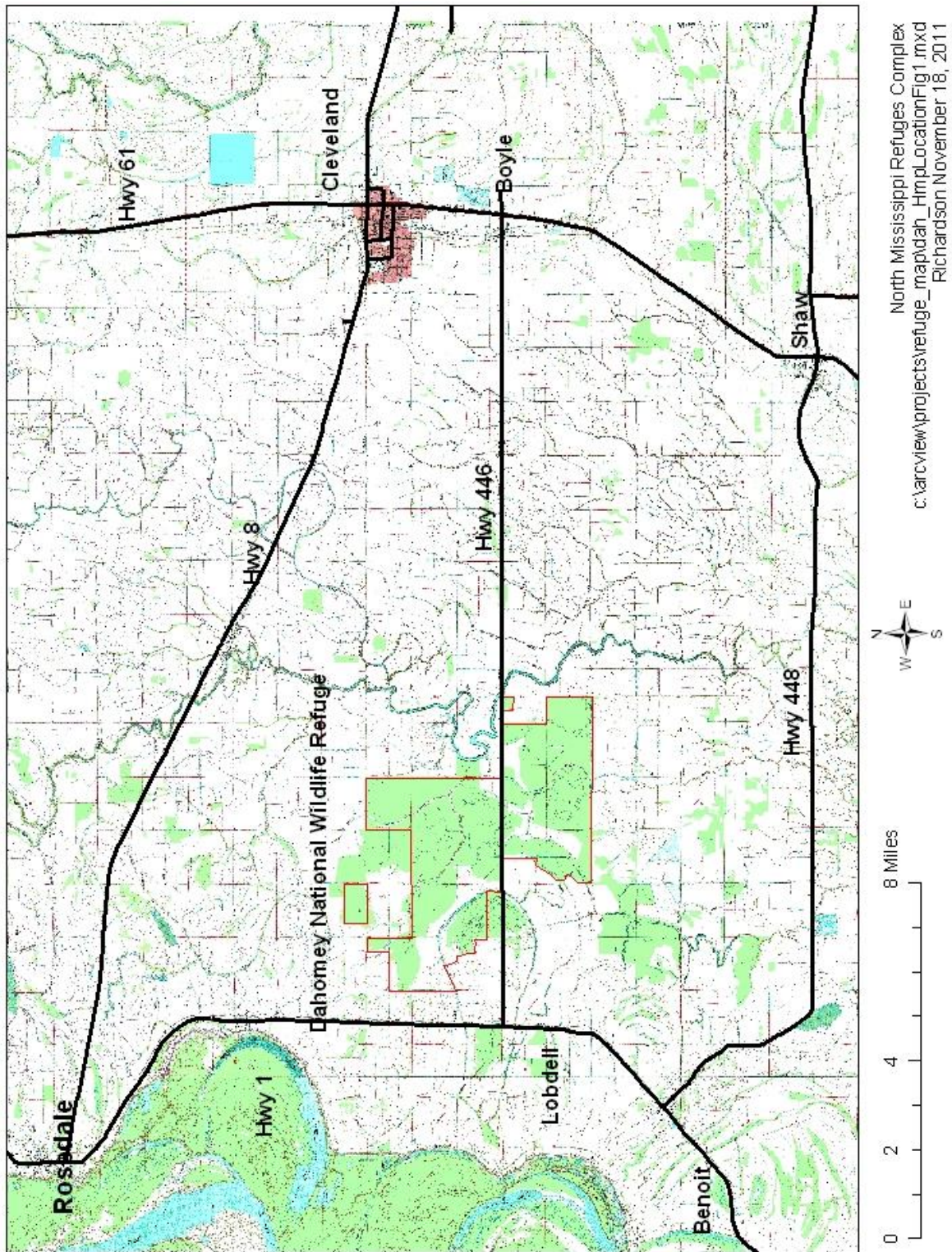


Figure 2. Major habitat classification for 48 management units on Dahomey National Wildlife Refuge.

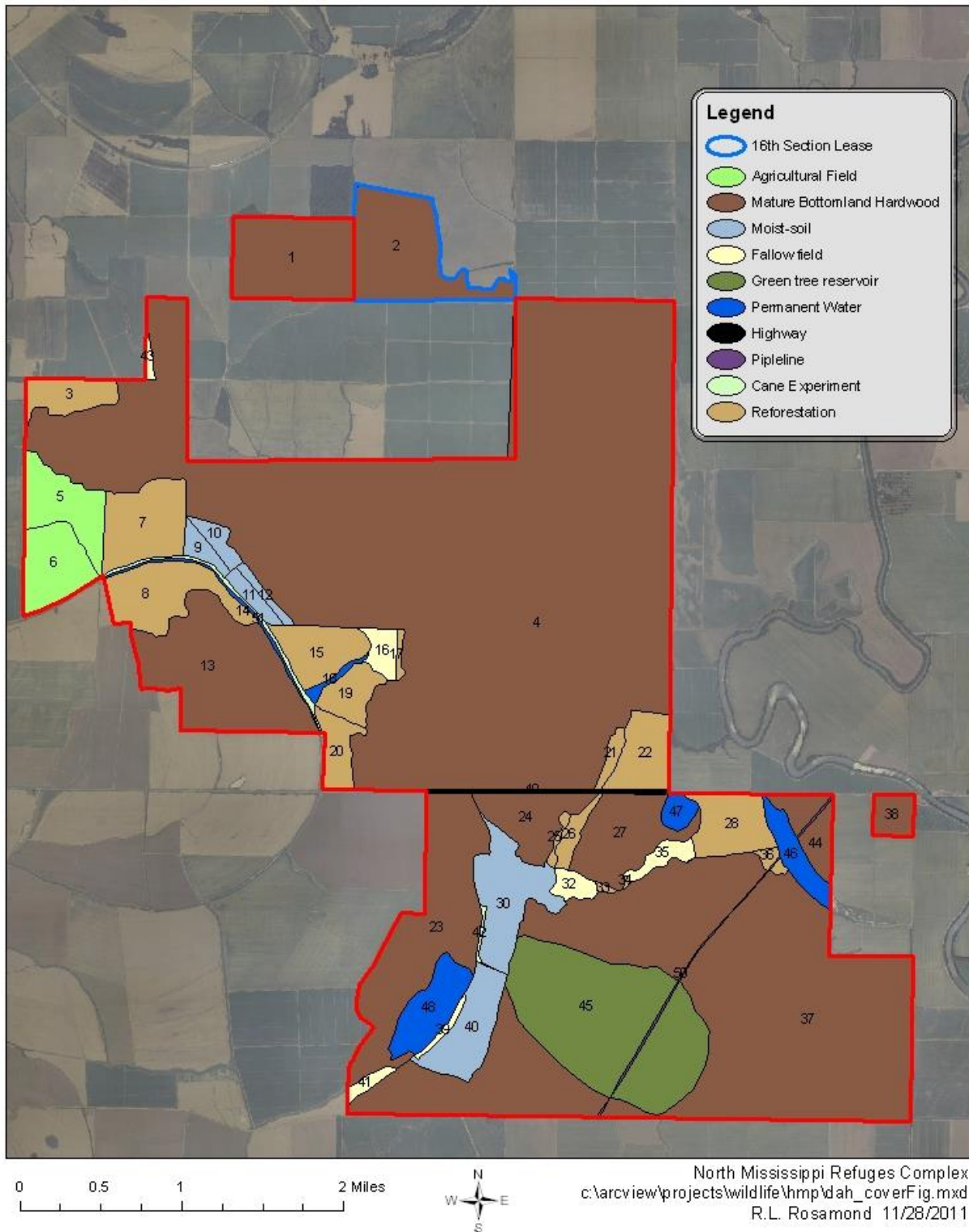
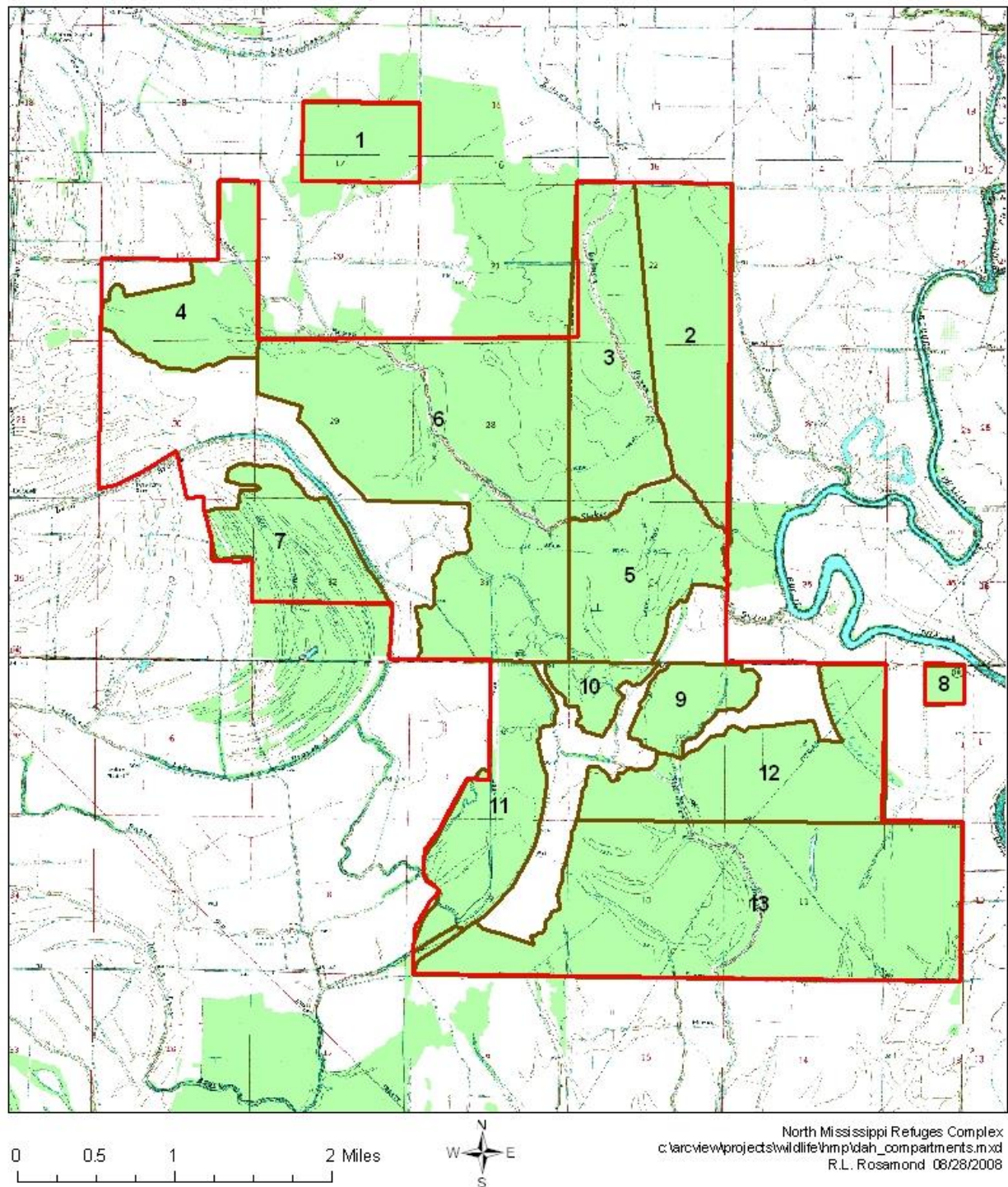


Figure 3. Forest compartment units used to establish gross inventory and monitoring information of forest stands on Dahomey National Wildlife Refuge.



Physical Features

Climate

The temperature ranges between 34⁰ F and 75⁰ F during winter months; summer temperatures range between 69⁰ F and 92⁰ F. The relatively warm and humid weather allows for >220 days of agricultural growing in the Delta. Annual precipitation averages 54 inches. Rainfall occurs relatively uniform across the year with slightly more rain during the winter months. Driest conditions occur in August and September. Though rare, extreme low temperatures occur during the winter months often associated with rain. In 1994, an ice storm devastated the Delta resulting in massive property damage and overstory tree breakage.

Topography and Hydrology

The topography of the refuge was formed in part from significant changes in channel of the Mississippi River over millions of year. In addition, the annual alluvial deposits from flooding of the Mississippi each spring prior to flood control measures in the mid-1800s created ridges and swales across the landscape. The refuge relief is nearly level with elevations ranging from 130-140 feet above MSL (LOBDELL, Mississippi Quadrangle 1967). The highest ground on the refuge is to the west with a gradual slope in the regional landscape to the southeast. Elevation changes of only a few feet over a mile are typical.

The refuge lies within the major watershed of the Yazoo River drainage basin and the secondary watershed of the Big Sunflower River. Prior to the flood prevention control measures along the Mississippi River erected during the late 19th and early 20th century, annual spring flooding would have occurred across the refuge depositing fine loam. However, flood abatement programs have curtailed all significant flooding for >60 years. Presently, the only major river system which influences the refuge is the Bogue Phalia which lies 0.5 miles east of the refuge boundary. The Bogue Phalia serves as the principle drainage for the refuge with several intermittent streams including Belman Bayou, Stillwater Bayou, Stokes Bayou and Christmas Lake Branch emptying into it. In wet years, Bogue Phalia will flood, causing water to back up in these tributaries and flood forested areas of the refuge. Flood frequency for the refuge is once about every three years, short in duration, and very limited in area of inundation.

Significant modifications to the surface drainage of the refuge and the adjacent agricultural fields bordering the refuge are evident and extensive. Nearly all adjacent agricultural fields on private lands have created ditches to facilitate drainage in spring. Improved drainage within the old fields on the refuge which have subsequently been largely reforested still exists. In addition, spoils along Belman, Stokes, and Stillwater Bayous provide indications that major efforts occurred to prior to the 1990, to get winter waters off the landscape to facilitate early planting of corn, soybean, and cotton. Collectively, these drainage ditches, canals, and flumes have undoubtedly reduced the overall soil moisture into the growing season and affected the plant communities accordingly.

Table 1: Acreage, purpose, and habitat type for 48 habitat management units on Dahomey NWR.

Unit	Size (acres)	Habitat Type (see Sect.2.4.3)	Purpose	Habitat Description
1	240	BH	Bottomland Hardwood Forest Habitat	Mid-successional Bottomland Hardwood
2	253	BH	Bottomland Hardwood Forest Habitat, 16 TH Section Lease	Mid-successional Bottomland Hardwood
3	71	R-BH	Bottomland Hardwood Forest Habitat	<20 year Hardwood Reforestation
4	3898	BH	Bottomland Hardwood Forest Habitat	Mid-successional Bottomland Hardwood
5	122	A/MS	Cooperative Farm - Sharecrop	Agricultural Field
6	121	A/MS	Cooperative Farm - Sharecrop	Agricultural Field
7	153	R-BH	Bottomland Hardwood Forest Habitat	Bottomland Hardwood Reforestation
8	151	R-BH	Bottomland Hardwood Forest Habitat	Bottomland Hardwood Reforestation
9	26	A/MS	Agricultural/Moist-soil Wintering Waterfowl	Agricultural/Moist-soil
10	26	A/MS	Agricultural/Moist-soil Wintering Waterfowl	Agricultural/Moist-soil
11	24	A/MS	Agricultural/Moist-soil Wintering Waterfowl	Agricultural/Moist-soil
12	15	A/MS	Agricultural/Moist-soil Wintering Waterfowl	Agricultural/Moist-soil
13	389	BH	Bottomland Hardwood Forest Habitat	Mid-successional Bottomland Hardwood
14	17	Aq	Open water-emergent vegetation	Permanent Wetland
15	100	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
16	33	FF	Natural Field Succession – Reforestation – Public Wildlife Viewing	Fallow field
17	8	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
18	12	Aq	Provide permanent water/Wildlife Observation	Permanent Wetland
19	60	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation

Unit	Size (acres)	Habitat Type (see Sect.2.4.3)	Purpose	Habitat Description
20	57	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
21	18	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
22	93	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
23	398	BH	Provide bottomland hardwood forest habitat	Mid-successional Bottomland Hardwood
24	117	BH	Provide bottomland hardwood forest habitat	Mid-successional Bottomland Hardwood
25	8	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
26	27	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
27	167	BH	Provide bottomland hardwood forest habitat	Mid-successional Bottomland Hardwood
28	106	R-BH	Provide bottomland hardwood forest habitat	Hardwood Reforestation
30	163	A/MS	Agricultural/Moist-soil Wintering Waterfowl	Agriculture/moist-soil
32	26	R-BH	Natural Field Succession – Reforestation	Natural Hardwood Reforestation
33	3	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
34	1	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
35	29	FF	Natural Field Succession - Reforestation	Fallow field
36	12	R-BH	Provide bottomland hardwood forest habitat	Bottomland Hardwood Reforestation
37	1791	BH	Provide bottomland hardwood forest habitat	Mid-successional Bottomland Hardwood
38	40	BH	Provide bottomland hardwood forest habitat	Mid-successional Bottomland Hardwood
39	10	FF	Natural Field Succession - Reforestation	Fallow field
40	119	A/MS	Agricultural/Moist-soil-Wintering Waterfowl	Agriculture/Moist-soil
41	15	R-BH	Natural Field Succession – Reforestation	Natural Hardwood Reforestation

Unit	Size (acres)	Habitat Type (see Sect.2.4.3)	Purpose	Habitat Description
42	5	FF	Natural Field Succession - Reforestation /Visual Barrier	Fallow Field
43	8	FF	Natural Field Succession - Reforestation	Fallow field
44	74	BH	bottomland hardwood forest habitat	Mid-successional Bottomland Hardwood
45	563	BH	Green-tree Reservoir - Waterfowl	Mid-successional Bottomland Hardwood
46	58	Aq	Provide permanent water	Slough
47	25	Aq	Provide permanent water	Slough
48	99	Aq	Provide permanent/temporary water	Slough
50	12	FF	Right-of-Way for Natural Gas Pipeline	Grassland
51	23	FF	Provide grassland habitat	Cane experiment

Soils

Soils in the region reflect the historical flooding of the area, composed of hydric soils predominantly formed from Mississippi River alluvium (U.S. Dept. of Agriculture 1958). There are 2 soil associations represented on the refuge: Dowling-Alligator-Sharkey and Forestdale-Dundee-Bosket (Figure 5). The Forestdale-Dundee-Bosket association is on the western edge of Christmas Lake Branch, an old stream meander. These soils developed on old natural levees and in depressions or in channels of former streams. The relief is relative flat though slopes of 7-10% may exist, soil pH is acidic and drainage is poor to excessive. These soils have high potential for row crop production.

The majority of the refuge is Dowling-Alligator-Sharkey association. The dominant soil series across the refuge, Sharkey clays, are generally formed in historical slack-water areas, often some distance from stream and river channels, where flood waters slow and allow the clays to settle out. These soils are typically difficult to farm given the high clay content, slow permeability, and often require artificial drainage to remove excess water. Relief is 0-1% and soils acidity is considered medium. A more extensive review of each soil series and type is provided by U.S. Dept. of Agriculture (1958).

Geomorphology

The refuge resides within the Mississippi Alluvial Plain. The area located east of the Mississippi River is referred to as the Delta and extends from southern Illinois to northern Louisiana. The Delta was formed over millions of years as unconsolidated sediments were deposited which occurred concurrent with shifts in the flood plain. The alluvial soils

were the product of sediments from the annual overflow and inundation of the Mississippi River across the Delta. The recurrence of soil deposits created relatively young soils geologically. The cessation of annual flooding from the Mississippi coincided with the major flood abatement project to build the main levee around 1859 and other efforts into the mid-1900s (U.S. Dept. of Agriculture 1958).

The overall Delta is relatively flat with elevation changes of <5 feet within a mile and considerably less as one moves further from the river to the Loess Hills. Elevations of 100-165 feet typically occur within the region. Because the natural hydrological flow of the Mississippi has been so altered through flood abatement, the historical vegetative communities are unlikely to develop in the same manner and many microhabitats which relied on higher moisture retention may cease to exist.

History of the Refuge Lands

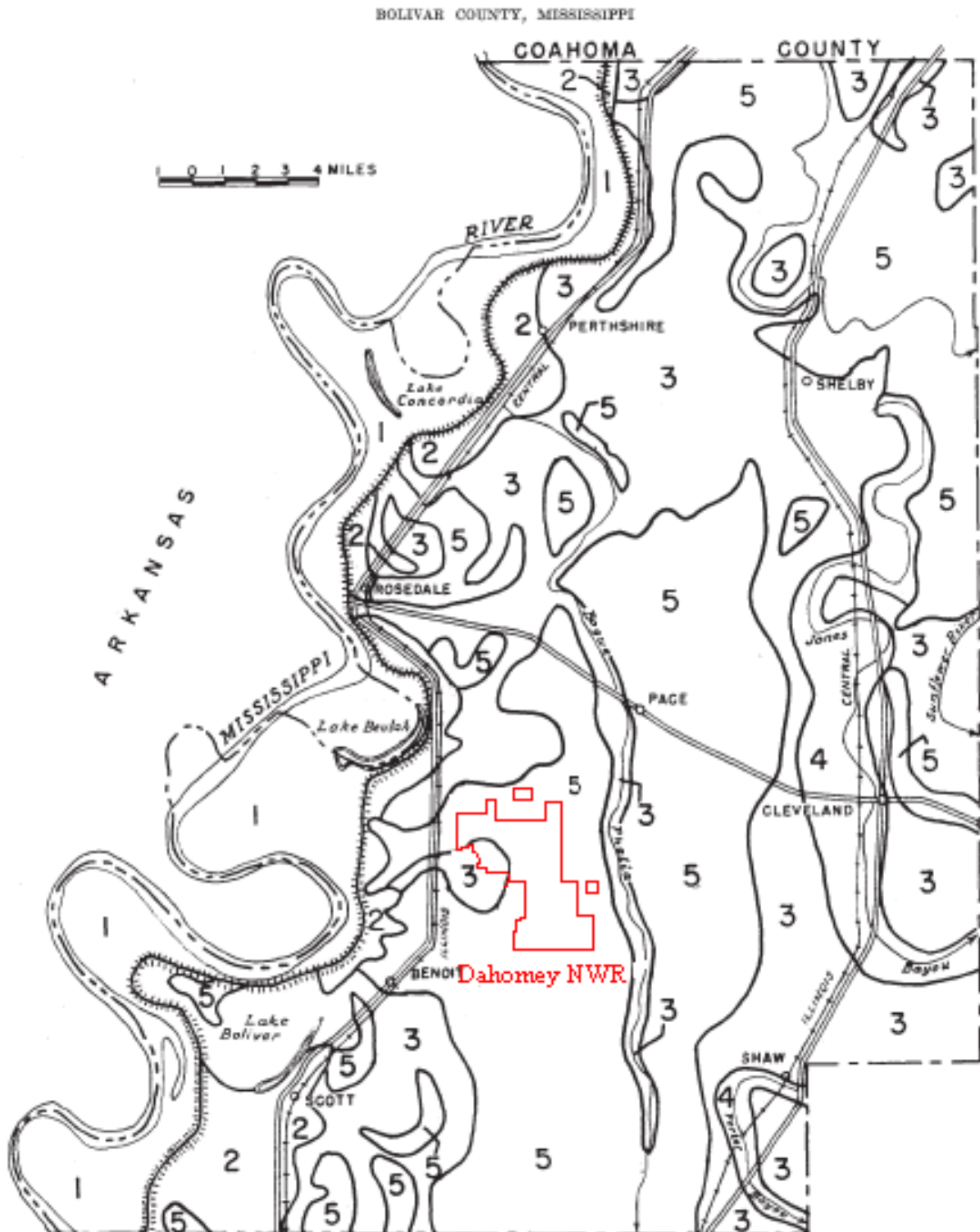
The present vegetative communities and associated wildlife resources reflect land use practice at the local (refuge landholding), landscape (Mississippi Delta), and Regional (Mississippi Alluvial Valley) scales. The pre-European period is a time line which the Refuge Vision attempts to emulate as the vegetative community and associated wildlife. However, alterations in the topography, hydrology, and the overstory vegetative community since European settlers came to the Delta have irrevocably altered the dynamics of the ecosystem. Many species such as the ivory-billed woodpecker, cougar, elk, bison, and red wolf have been extirpated from the region with little chance of ever being re-established. Many other species like the black bear hold on with limited opportunity to expand populations within the fragmented landscape. Given the extent of these modifications to the physical structure and the influence on native wildlife, fish, and vegetation, it is unlikely that a fully functioning ecosystem can be represented on the remaining lands held for conservation. Nonetheless, the Refuge Vision reflects efforts to restore, enhance, and conserve a large contiguous forested wetland and the representative wildlife and plant communities within the northwest portion of the Delta.

Understanding the history of the landscape at the local and landscape level can help to refine habitat goals for the HMP and provides a foundation for establishing objectives and appropriate strategies to achieve them.

Cultural and Refuge Land History

Undoubtedly Native Americans have inhabited the Delta for thousands of years occupying the area some 10,000-12,000 years ago during the Paleo-Indian Period. It is only within the Mississippian Period that Native Americans began to extensively farm crops, first on relatively open natural levees and secondarily on land which they cleared through fire. The effect on the vegetative and wildlife community at local and region landscape was negligible compared to the effects of post-European settlement (Saikku 2005).

Figure 4. Soil associations in Bolivar County: 1. Alluvial soils; 2. Commerce-Robinson-Crevasse; 3. Forestdale-Dundee-Bosket; 4. Brittain-Pearson-Dexter; 5. Dowling-Alligator-Sharkey and location of Dahomey NWR – (modified from U.S. Dept. of Agriculture 1958).



The cultural landscape of the Delta began to change as European settlers began moving to the region. The fertile soils were good for growing row crops. The demand for cotton grew in the 1800's and soon vast areas of the Delta were being cleared. The nearly contiguous bottomland hardwood forest was being harvested at an unprecedented rate for valuable lumber. As the trees fell, fields of cotton and other agricultural crops were planted. During this period, farmers were contending with annual spring floods that often caused crops to fail. Slowly, levees were being raised to hold back the spring waters and bring stability to the agricultural community. After the Civil War, significant advancement in clearing of the vast Delta occurred. By then, local, state, and federal entities had combined resources to improve upon the mainline levee of the Mississippi and expand its development north. Floods continued to occur in the Delta but less frequently. Farmers continued to improve their fields by ditching areas making planting much easier in spring. Of the remaining forested area, heavy timber cutting had occurred and "high grading" of the most valuable trees was common. Thus, stands contained species of water hickory, overcup oak and other less merchantable trees. Second growth forests were limited given an overwhelming demand for land devoted to production of cotton and corn.

Dahomey NWR is located on the grounds of the old Dahomey Plantation founded in 1833 by F.G. Ellis and named after the homeland of his slaves. Much of the land west of the refuge was probably cleared for cultivation around this time. The land went through several owners and was purchased by Allen Gray in 1936. The portion that became the refuge was known as the "Allen Gray Woods". This was the only significant portion of the plantation still forested. This section of the property was leased to the Benoit Hunting Club (beginning circa 1949) while the agricultural lands were leased to local farmers for cultivation. In 1990, the Nature Conservancy purchased the land to hold for the Fish and Wildlife Service. Until the Service was able to purchase the lands, the agricultural fields were leased to farmers by the Conservancy, while the forested area was leased to the Service. Over the following 3 years, the Service purchased the land from the Nature Conservancy. By 1993, the Service had acquired fee title to all 9,269 acres. In 1991, the Mississippi Department of Transportation transferred 162 acres to the Service as a wetland mitigation bank. Since that time, no additional lands have been added to the refuge though the approved acquisition boundary includes an additional 2,207 acres. A proposed expansion of 46,000 acres has been submitted to Washington. This would encompass the remaining portion of Dahomey Plantation and other agricultural lands. In addition, a large forested area within the batture would be included as a linkage to other Service and State conservation lands in Arkansas.

2.4.2 *Pre-European Habitat Conditions*

The Mississippi Alluvial Valley historically was predominantly forested wetland extending from southern Illinois to southern Louisiana. The bottomland forest within Mississippi was estimated to exceed 5.9 million acres (Putnam et al. 1960). Native Americans created small openings for agriculture within the MAV, and may have regularly burned higher ridges, perhaps culminating in large canebrakes within the MAV. The bottomland hardwood forests were diverse in many regards. The moisture gradient of the soils dictated tree composition. Drier sites were abundant with a mixture of red oak species dominated by water, willow, nuttall oak, interspersed with sweetgum, bitter

and sweet pecan. Wetter sites would have contained overcup oak, water hickory, and green ash. The sloughs, breaks, and swamps were a vast forest of bald cypress. Smaller areas were dominated by water tupelo. The virgin cypress stands may have encompassed as much as 30% of the Delta (Saikku 2005).

There is much debate as to the extent of oak composition within stands in the MAV. Ouchely et al. (2000) has suggested that the dominant overstory hardwood was sweetgum. Furthermore, the landscape contained trees of enormous diameter and varying age classes (Ouchely et al. 1999). Undoubtedly, the original virgin forest contained a diversity of species and herbaceous understory vegetation that is no longer represented in the same capacity of the second growth forests in the Delta.

The understory vegetation in the areas would likely have been equally diverse depending on the moisture gradient. The natural levees, and ridges and swales influenced the herbaceous composition. Giant cane was believed to be an important component within the flood plain forest. Large assemblages of cane (i.e., canebrakes) created microhabitat types hosting species unique or specialized.

Current Condition and Habitat Types

The refuge lies on the western portion of the Mississippi Delta, 3 miles east of the mainline levee. The forested wetland communities of the region were a reflection of the annual flooding in spring of the Mississippi River. However, significant alterations to the hydrology and past land use practices have drastically altered the vegetative community to the current condition and habitat types found on the refuge.

Dahomey NWR consists of 9,431 acres. The refuge is predominantly a second growth bottomland hardwood forest. Approximately 8,100 acres are bottomland hardwood, 900 acres of hardwood reforested agricultural fields, and 500 acres comprised of agricultural/moist-soil units and fallow fields. Approximately 100 acres of the refuge is classified as sloughs and bayous. The refuge has an extensive interior gravel road system and marginally improved foot trails. A work center/office is located along State Road 446. Seven shallow water wells (~150-200 feet deep) are situated near existing fields for irrigation purposes.

Fallow Fields (FF)

Fallow fields on the refuge are comprised of previously agriculturally farmed units taken out of force-account or cooperative farming over the past 15 years, wide non-forested areas between other habitat types, or areas maintained as permanent right-of-way. Units range in size from 8 – 33 acres and are scattered across the refuge. Most of the fields continue to be allowed to naturally succeed into hardwoods with the exception of a portion of Unit 16 near the Happy Hollow Lake Observation Tower planted for environmental education. A buried natural gas line bisects the eastern edge of the refuge south of Highway 446. This permanent right-of-way is maintained in low grass through annual mowing. Collectively, the fallow fields have promoted

some additional avian species richness but are also sources for brown-headed cowbird parasitism on interior forested bird

Agricultural/Moist-soil (A/MS)

In combination, the refuge has approximately 516 acres classified as agriculture/moist-soil (Table 2). These are aggregated together given the use capabilities and purpose of the habitats. These range in size from 15-163 acres each varying in management capability based on water availability to flood and relief. Units 5 and 6 (243 acres) have no or limited capability at present to flood and do not receive any dry land foraging by ducks or geese. The refuge has primarily managed all the units through a cooperative farming program in which the Service receives at a minimum a 25% share of the planted crop to be retained in the field for migrating and wintering waterfowl. The principle crop has been corn; however, units 9-12 are suitable to grow rice given the relatively flat nature of the fields and associated well. Water control structures exist for each unit to manipulate water levels (exception – no structures in units 5 and 6). Improvements to units 30 and 40 were done in cooperation with Ducks Unlimited in 2001 to improve or extend levees making flooding of the areas more efficient. Moist-soil management is limited given the relatively rapid drying of units in spring and the only source of water being from a well. In addition, Units 9-12 which best suited to produce moist-soil vegetation have a flow through water system in which water must go through multiple units to flood them from the well source.. These agricultural/moist-soil units represent the principle food resource for migrating and wintering waterfowl on the refuge.

Table 2: Unit, acreage, and management capability of agricultural/moist-soil units on Dahomey NWR.

Unit	Acreage	Management Capability
5	122	Cereal grain production – a limited portion floodable by a well though construction of a levee would need to be done to fully flood unit
6	121	Cereal grain production – not floodable
9	26	Relatively level – planned for precision leveling in 2012 – floodable by well. Best suited for rice or moist-soil plant production
10	26	Relatively level – planned for precision leveling in 2012 – floodable by well. Best suited for rice or moist-soil plant production
11	24	Relatively level – planned for precision leveling in 2012 – floodable by well. Best suited for rice or moist-soil plant production
12	15	Relatively level – planned for precision leveling in 2012 – floodable by

Unit	Acreage	Management Capability
		well. Best suited for rice or moist-soil plant production
30	163	Cereal grain production – floodable by well, northern 1/3 of unit is not floodable without additional levee construction
40	119	Cereal grain production – floodable by well

Aquatic Habitats (Aq)

Permanent or semi-permanent aquatic habitat is very limited on the refuge. Christmas Lake Branch (unit 14) and Happy Hollow Lake (unit 18) are small open bodies of water with a limited fishery. Christmas Lake Branch is an old stream meander bend, which receives the majority of its flow from agricultural runoff and has a high nutrient load. In the summer the lake has a low dissolved oxygen level and thus supports only a small fishery of minnows and aquatic invertebrates. Happy Hollow Lake is a man-made impoundment along a natural drainage into Christmas Lake Branch. This lake has been stocked with bass and bream.

Two natural sloughs (Units 46 and 47) are dominated by emergent vegetation (smartweed and buttonbush) and second growth bald cypress along the edges. Only a few old bald cypresses remain. Unit 48 is a semi-permanent forested wetland influenced by beaver impounded water from a drainage ditch along Well Road. Other smaller semi-permanent wetlands are scattered across the refuge, primarily formed by beavers. Many dams within roadside ditches are removed annually by the refuge staff. Some impoundments within the drainages of the forested area are left year round to naturally dry over the course of the summer.

The only major stream systems on the refuge are Belman Bayou, Stokes Bayou, and Stillwater Bayou. These are narrow intermittent systems (<40 feet wide). Belman and Stokes Bayous serve as the principle drainage for the forest north of State Road 446 and other agricultural lands off refuge. Stillwater Bayou originates just south of State Road 446 and drains the central portion of the refuge. Because of the intermittent nature of the bayous, there may be a seasonal fishery which migrates upstream from Bogue Phalia but during the summer the systems are dry or have only small remnant pools.

Bottomland Hardwood (BH)

Bottomland hardwood forests are a reflection of many natural factors which dictate species occurrence, density, and the assemblage with other vegetation. The principle factor which may limit hardwood tree species occurring on a site is soil moisture. Even small changes in moisture gradient may shift species

composition. In addition, previous silviculture greatly affects second-growth forest overstory and understory diversity.

The bottomland hardwood forest of the MAV is an extremely complex interaction of the vegetative community and abiotic factors which affects wildlife diversity. Tree age and species composition, position in the canopy, and understory vegetation are dynamic. The spatial and temporal changes may be localized in the forest or wetland and only recognized if the magnitude of the affect is acute and large (e.g., windthrow, tree harvest, dewatering of a wetland) as opposed to periodic gaps formed from the loss of individual trees. The time-frame from which one measures the change can also affect the interpretation. Given the longevity of a cypress tree (>500 years), it is difficult to have any appreciable understanding of the natural change and development of the forest and the organisms that rely on the vegetative community. Even for shorter lived tree species, our period of reference on how the hardwood system adjusts and changes is vague.

It is recognized that some hardwood trees adapt better than others to different moisture gradients and this tends to dictate the distribution of species with the wettest sites being composed of bald cypress and water tupelo, slightly less wet sites having water hickory and overcup oak, and many of the other red oaks and their associates on the driest sites. This information is most relevant when trying to reestablish hardwoods on harvested areas or reforest agricultural fields. The actual composition of the forest is also difficult to determine. Ouchley (2000) suggests sweetgum dominated much of the bottomland hardwood forest compared to oaks. However, the second growth forest of the 20th century is a by-product of the early timber harvests, flood control measures, and silviculture to favor high value trees.

The most critical abiotic factor that influenced the forested wetlands of the MAV was annual flooding. The flood abatement projects have in essence permanently erased this process from its influence. In addition, the remaining water regime is a function of winter rains being purposely removed through an extensive system of small ditches and improved canals to facilitate agriculture planting in spring. Therefore, the influence of the moisture gradient in the hydric soil conditions no longer exists on the plant community at local and landscape level.

Given the complexity of the bottomland hardwood system, it is inherently obvious that wildlife diversity is a direct function of the structure of the vegetation. Of notable concern is the diversity of resident and Neotropical migratory songbirds which breed in the bottomland hardwood forest. Many common species are generalist while others are found less frequently given the reliance on specialized microhabitat characteristics within the larger landscape. Some of these species are in decline or at reduced population levels but none are considered threatened or endangered or candidates for listing under the ESA. Declining or otherwise vulnerable songbirds involved could be responding to both breeding and non-breeding habitat issues, but the positive responses to modest attempts at habitat improvements thus far suggest continued efforts at improving habitat conditions that in many ways mimic historical older-growth bottomland forests is prudent,

with needed consideration given to the habitat requirements for priority resident species such as forest bats and black bear. For these and other resident species, it is well understood that these species often depended on other unique features of what constituted historic old-growth forest stands (e.g., large snags, down woody debris, and other features associated with a higher proportion of dead and dying wood than would be found in younger forests) and will not simply respond to reforestation of bottomland hardwoods. Identified limiting factors including population isolation/extirpation, habitat fragmentation, and low source populations may preclude increases in species like the black bear, bats and pondberry.

Therefore, the ecological integrity of the bottomland hardwood forest may best be served through both an increase in the area under direct conservation and linking forest blocks together and improving upon what are now mostly mid-successional (closed canopy, stem exclusion stage) conditions. The former can reduce the adverse effects of fragmentation and allow the natural process of plant-animal communities to interact in space and time. Regarding the latter, management of hardwood forest until recently has centrally been a function of selective stand thinning or clearcuts at the stand level based mostly on commercial criteria. Such actions need to be carefully reviewed given the longevity of any negative implications resulting from hardwood timber harvests as described by Hamilton et al. (2005). As a response in part to many of the same concepts discussed by Hamilton et al. (2005; original presentation was in 1999) the LMVJV established a Forest Resource Committee in the late 1990s to develop desired forest conditions for bottomland hardwood targeting priority wildlife (LMVJV 2007). Changes are underway to incorporate these concepts especially on public forest lands, including National Wildlife Refuges such as at Dahomey. In fact, Hamilton et al. (2005:373) recognizing that old-growth bottomland hardwood forest remnants are few, widely scattered, and small in size stated: "We are not advocating hands-off management because we cannot wait hundreds or thousands of years necessary for forests to reach the climax condition. Younger forests should be managed to stimulate old-growth by eliminating harvest of older stands, and establishing tree-fall gaps of the same size and frequency as in original climax. Trees removed to form gaps can be killed and left standing or allowed to fall. This increases the amount of snags, fallen deadwood, etc., that also are characteristic of old-growth forests."

Bottomland hardwood forest is the largest habitat classification on Dahomey NWR representing approximately 8,100 acres (84% of the cover type). The entire refuge is a second and third growth stand stemming from the oldest stands dating to the 1930s. However most stands were clear cut in 1969 and high-grading of stands through 1983 has altered species composition and age class across the refuge (Parks and Tomlinson 1988). The forest stands on the refuge average 50 years old. None of the current forest stands were believed to have ever been cleared for agriculture. Logging activities from the 1969 harvests left extremely large "cull" trees across the landscape consisting of bitter pecan, Nuttall oak, water oak, and honey locust. Most stands at Dahomey due to high-grading are best considered today as mid-successional (stem exclusion stage with

little vertical or horizontal structure evident) with scattered relict (“cull”) trees which were left due to their non-merchantability during prior harvests (and which today often serve as important roosting and denning trees). Since acquisition by The Nature Conservancy in 1990, no harvests have occurred on the refuge. Many of the agricultural fields were quickly taken out of production and reforested (Section 2.3.4.5). The most significant alteration to the forested habitat since Service ownership came from a February ice storm in 1994. According to the 1994 Annual Narrative, damage was “uniform and complete” with the majority of the trees losing their tops and major limbs, but even with this damage the mid-successional conditions still dominate the forest.

Presently, the refuge can be classified in three major bottomland hardwood types: Willow Oak-Water Oak-Diamondleaf Oak (SAF 88), Swamp Chestnut-Cherrybark (SAF 91d) and Sweetgum-Willow Oak (SAF 92) (Eyre 1980). However, some of the drier sites are now more characteristic of Sugarberry-American Elm-Green Ash (SAF type 93), which normally would be considered “swamp forest.” This shift in composition is probably due to past high-grading with resulting closed canopied conditions favoring these and other shade-tolerant trees (e.g., maples, boxelder; see Smith and Sansing 2008). Stands on the refuge were not exclusively delineated based on classification and 2-3 types may be present in the same stand. Oak composition within stands consists of Nuttall oak, water oak, and willow oak with lesser amounts of overcup oak, swamp chestnut oak, and cherrybark oak. Other common overstory trees include cedar elm, honey locust, sugarberry, green ash, sweetgum, and bitter pecan. Less frequent species include cherrybark oak, swamp laurel oak, persimmon, eastern cottonwood, American elm, and sycamore (U.S. Fish and Wildlife Service 2001). Previous owners split the forest into 13 compartments, which are still used to designate the management units of the forested area (Figure 3). Two of the thirteen compartments were inventoried in 1999; the remaining 11 were previously assessed in 1988. A more current forest inventory at the compartment level was conducted in spring 2008 (Smith and Sansing 2008). However, compartment boundaries were shifted and a comparison to the existing compartment delineation has not been completed. In addition, the inventory needs to be reanalyzed at the stand level.

Much of the Dahomey forest has sparse understory. Whatever effects resulting from an ice storm that hit the refuge in 1994, breaking the tops and upper limbs from nearly all overstory trees, has largely dissipated as crowns from repeatedly high-graded stands close quickly. Giant cane is fairly abundant along edges across the refuge (Smith and Sansing 2008), but dense patches within forest stands are largely absent away from road edges or other large openings; this is an important consideration for providing nesting and the specialized foraging habitat for Swainson’s Warbler, not to mention important habitat for many other priority species including American Woodcock and black bear. The refuge also has dense stands of pawpaw in certain areas (e.g., Calico Woods Stand 13). This species is typically associated with richer sites and would typically have been cleared to grow cotton. As a result, there are few such stands of pawpaw in the Delta. The Dahomey forest also has a heavy vine component with crossvine, peppervine, but

again most dense vine patches now are restricted to forest edges along roads or ditches. Forest management to open the canopy would benefit all of these important forest composition and structural components, releasing giant cane, paw-paw regeneration, and vines. Finally, the inventory conducted by Smith and Sansing (2008) found little in the way of advanced oak regeneration, but widespread indications were found that without appropriate management the composition of the Dahomey forest is shifting towards shade tolerant species.

Reforested Bottomland Hardwood(R-BH)

At the time of acquisition, 1,300 acres of agricultural fields were annually grown in corn, cotton, rice, or soybean depending on location and ability to pump water from shallow wells for irrigation. Since 1992, approximately 900 acres have been reforested to hardwood trees through acorn seeding and later direct root-stock planting. A mix of hardwoods species including Nuttall oak, water oak, willow oak, green ash, sweetgum, and persimmon were planted on 12' x 12' wide row spacing. Low lying areas were planted with bald cypress; no water tupelo was planted.

Invasive species (i.e., Wild Pigs)

Invasive species are a major threat to many ecosystems through the direct and indirect displacement of native species and often have long-term negative consequences to the habitat. An "invasive species" is defined as a species that is 1) non-native (or alien) to the ecosystem under consideration, and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. (Executive Order 13112). Within the Southeastern United States, wild pigs are the most serious vertebrate threat to whole ecosystems.

Wild pigs represent a hybridization of domestic pigs which were historically free-ranged livestock and released Eurasian or Russian wild boar (undomesticated form of pig). Wild pigs are extremely adaptable to their environment and are opportunistic omnivores which readily adjust to changes in availability of food resources by switching diet or dispersing. Within the MAV, the wild pig has become well established, residing within remnant forested areas and capitalizing on the abundance of native foods and agricultural crops (Hamrick et al. 2011). Roots, tubers, seeds, and herbaceous plants constitute 90% of the diet of wild pigs. They readily consume acorns in fall and root for grubs and other buried foods. In the batture, only during periods of flooding in late winter and early spring will they be displaced often resulting in reestablishment of controlled or extirpated populations. Perhaps the only habitat component which restricts or limits wild pigs is availability of water. Wild pigs tend to be associated with wetlands as a means of finding water to drink and cool during warm weather.

Wild pigs are invasive and are implicated in economic and environmental damages, cause habitat destruction, compete with native wildlife for food resources, and predate birds, reptiles and amphibians (Gibson et al. 1998, Ditchkoff and West. 2007). The Delta region of Mississippi has a tremendous wild pig population. All

forested areas with sources of permanent to semi-permanent wetlands serve as source locations for these animals. The agricultural landscape of the area strongly favors the species, providing unlimited food resources.

Habitat Changes from Historic to Current Conditions

Dahomey NWR is located on the grounds of the old Dahomey Plantation founded in 1833 by F.G. Ellis and named after the homeland of his slaves. Most of the land west of the refuge outside the mainline levee was gradually cleared of virgin forest for cultivation of cotton and corn. During the same period, the hydrology of the area began to be drastically modified as flood control measures were raised along the Mississippi River which ultimately prevented the renewal of soil fertility by annual deposition of silt from spring floods. The entire Yazoo-Mississippi Delta was enveloped in an agricultural boom and little of the highly prized hardwood species were left in significant tracts for harvest. Cleared lands with heavier soils were difficult to work and drainages along field borders were created to facilitate farming. Subsequently, flumes were built adjacent to some drainage for irrigating row crops to increase production.

The Dahomey plantation was eventually purchased by Allen Gray in 1936. The portion that became the refuge was known as the “Allen Gray Woods”. The forested area was leased to the Benoit Hunting Club (beginning circa 1949) while the agricultural lands were leased to local farmers for cultivation. It is surmised that some small remaining wood lots were cleared for agriculture but the bulk of the forested area was retained in trees. In 1990, The Nature Conservancy purchased the land to hold for the Fish and Wildlife Service. Until the Service was able to purchase the lands, the agricultural fields were leased to farmers by the Conservancy, while the forested area was leased to the Service. Over the following several years, the Service purchased the land from the Nature Conservancy. By 1993, the entire holdings of the Nature Conservancy (9,272 acres) had been purchased by the Service. In 1991, the State Highway Department transferred 162 acres to the Service as a mitigation bank.

At the time of purchase, the refuge contained approximately 1,300 acres of agricultural fields, with the bulk of the remaining acreage consisting of forested areas. The forested portion of the refuge (approximately 8,100 acres) was most likely originally cut in the 1940's to provide lumber for the war effort. The forest was allowed to regenerate naturally. Additional harvests were made in 1969, 1978, and 1983. Crops cultivated in the agricultural fields included soybeans, rice, and wheat.

Cooperatively farmed acreage has gradually been reduced and concurrently the acres of hardwood reforestation increased (Table 3) since the Service took ownership. Most direct reforestation was completed by 2000 though small units continued to be allowed to naturally succeed to hardwoods. From the original 1300+ acres in agriculture, approximately 516 acres are being managed for migrating/wintering waterfowl.

In 1994, four moist-soil units were constructed in a previous agriculture field by subdividing the area with minor levees and installation of water control structures. The 4 units (9-12) total 88 acres. In 2001, Ducks Unlimited constructed two levees and installed water control structures around agricultural fields south of the MS Highway 446 (units 30 and 40). The levees and the presence of a well on each unit, allow portions of the area to be row cropped each year and flooded for migrating and wintering waterfowl.

In addition to the construction of floodable agricultural/moist-soil units, the Service has installed small water control structures in several ditches (impound < 1 acre). The Service developed a 540-acre green-tree reservoir (floods ~ 440 acres), located along Stillwater Bayou by installing two pipes in the drainage (Figure 2). This area is flooded every other year to provide additional bottomland habitat during the winter months.

The most significant alteration to the forested habitat since Service ownership came from a February ice storm in 1994. According to the 1994 Annual Narrative, damage was “uniform and complete” with the majority of the trees losing their tops and major limbs. Regardless of this event opening the canopy, whatever effects there were now are rapidly fading given the prevalence of mid-successional condition after repeated high-grading, with limited and decreasing persistence of dense understory now evident nearly twenty years later. Also, advanced hardwood regeneration especially of shade-intolerant species has not occurred. The overall composition of the forest is moving towards shade-tolerant species, and without corrective management there will be a loss of especially red oak in the future.

The effects of global climate change can be expected to gradually increase at Dahomey NWR over the next 100 years. Within the 15 year time-frame of this plan, smaller impacts may be seen. According to the report “Global Climate Change Impacts in the United States” (2009), it is expected there will be higher temperatures, less rainfall, particularly in winter and spring, increased storm intensity and frequency, and more drought throughout the Southeast. It is anticipated that temperatures will increase by at least 4.5°F by 2080 and fire severity will increase 10 to 30 percent within the next 50 years. Within the next 15 years, increasing impacts of higher temperatures will likely cause the spread of invasive species and incremental changes to native plant and animal distributions. Migratory birds will probably breed and winter a little further north. More southern, tropical species, (i.e. black-bellied whistling ducks, wood storks, etc.) will extend their ranges into Mississippi. Invasive species such as *Salvinia*, water hyacinth, tallowtree, etc. are expected to become more established and extend their ranges further north. The source of these impacts are difficult to isolate as caused either in part or in full by global climate change, but are anticipated nevertheless. This plan addresses the short-term anticipated impacts of invasive species and community shifts through habitat management objectives. Impacts including increased drought, fire severity, and storm intensity cannot be influenced by the scope of this plan. Management within the scope of this plan that interacts with larger climate change management includes the reforestation of agricultural fields, which is a positive approach to promote carbon sequestration. Although unlikely to significantly affect climate change impacts locally, this action does contribute to broad mitigation of human-induced global climate changes.

Table 3: Cooperative acres farmed and cumulative reforestation acreage from 1992 to 2008 on Dahomey National Wildlife Refuge.

Year	Farmed acres	Crop	Reforested acres * (Running Total)
1992	1,390	Soybeans, rice	111
1993	1,369	Soybeans, rice, wheat	132
1994	1,268	Soybeans, rice	242
1995	1,124	Soybeans, rice, wheat	242
1996	1,213	Soybeans, rice, corn	242
1997	1,066	Soybeans, rice	393
1998	1,036	Soybeans, rice, corn	393
1999	981	Soybeans, rice, corn, sunflowers	393
2000	722	Soybeans, rice	553
2001	531	Soybeans, rice	869
2002	531	Soybeans	869
2003	531	Soybeans, wheat	869
2004	490	Rice	869
2005	611	Soybeans, rice	869
2006	611	Soybeans	869
2007	610	Soybeans, milo, wheat	869
2008	616	Milo, wheat	900
2009	0	No Cooperative Farming	900
2010	615	Corn	900
2011	535	Corn	900
2012	282	Corn, Soybeans	900
2013	0	No Cooperative Farming	900

** Acres removed from agriculture were not always immediately reforested. Some were maintained as fallow fields, converted to moist-soil units, or allowed to regenerate naturally. (Source: NMRC annual narratives.)*

III. REFUGE RESOURCES OF CONCERN

Identification of Refuge Resources of Concern

Priorities associated with wildlife and habitat management for the NWRS are determined through directives, policies, and legal mandates. Resources of concern include individual species, species guilds (e.g., waterfowl, shorebirds), and/or habitat communities that support refuge purposes as well as Service trust resource responsibilities (i.e., threatened and endangered species, and migratory birds). Resources of concern are also native species and “natural” functional communities such as those found under historic conditions that are to be maintained and, where appropriate and possible, restored on a refuge (USFWS. 2011. Identifying Refuge Resources of Concern and Management Priorities, A Handbook:

<https://fishnet.fws.doi.net/regions/4/nwrs/HMP/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2Fregions%2F4%2Fnwrs%2FHMP%2FShared%20Documents%2F1%2DHMP%20Guidance%20and%20Support%20Documents&FolderCTID=0x012000DE6400DB0E7CAE4DAA6B28E47DA71ED9&View={493ACC28-E5A3-4890-8A63-5E910EA1090F}>).

Resources of Concern for Dahomey NWR were selected after taking into account the conservation needs identified within international, national, regional, or ecosystem goals/plans; state fish and wildlife conservation plans; recovery plans for threatened and endangered species; and the goals for the refuge set forth in the North Mississippi Refuges Complex Comprehensive Conservation Plan (CCP). The North Mississippi Refuges Complex CCP specifically identified several priority species that were grouped into the broad categories of migratory birds, state and federally listed threatened and endangered species that constitute Resources of Concern here (U.S. Fish and Wildlife Service 2005). The Refuge Vision (**Section 1.3**) attempts to meld all these concerns into a collective direction for the future management of the refuge. While there are other wildlife, fish, and plant resources which the refuge directly or indirectly affects, the Resources of Concern and the Refuge Vision fundamentally constitute the basis for management actions outlined within the HMP for Dahomey NWR.

The species/communities selected as Resources of Concern from these plans support at least one of the following NWRS mandates:

- **Support Establishing Refuge Purposes;**
- **Support the National Wildlife Refuge Mission; and**
- **Fulfill Service Trust Resource Responsibilities.**

Resources of Concern identified for Dahomey NWR include:

- **Migrating and Wintering Waterfowl (Refuge purpose; NWRS mission; Trust resource)**
- **Breeding Wood Ducks (Refuge purpose; NWRS mission)**
- **Forest Interior Birds (Refuge purpose; NWRS mission; Trust resource)**

- **Rafinesque's Big-eared Bat and Southeastern Myotis (NWRS mission)**
- **Black Bear (NWRS mission; Trust resource)**
- **Pondberry**

Migrating and Wintering Waterfowl

Dahomey National Wildlife Refuge was one of 5 refuges acquired to support wintering waterfowl habitat needs within the Lower Mississippi Alluvial Valley (MAV) as outlined in the North American Waterfowl Management Plan (U. S. Fish and Wildlife Service 1988). The MAV historically provided a vast expanse of flooded forested wetlands for wintering waterfowl (Reinecke et al. 1989) nearly 80% which has been lost to agricultural conversion and much of the remainder unavailable for waterfowl due to flood abatement practices along the major river systems. The reliance on smaller parcels (i.e., State Wildlife Management Areas and National Wildlife Refuges) to mitigate the losses through intensive habitat management is critical to achieving population goals.

The Lower Mississippi River Joint Venture (LMVJV) established habitat targets on federal, state, and private conservation areas. In setting habitat objectives, it was agreed that foraging habitat was the limiting factor. Objectives were set based on food production and acres by habitat type for a complex of habitats, including harvested and unharvested cropland, moist-soil areas, and flooded forest land. On Dahomey, this represented the annual availability of 750 acres of flooded forest wetlands, and 1000 acres of moist-soil habitat (R. Wilson, Migratory Bird Office, Jackson, MS, Pers. Comm. 2011). However, subsequent field review of those goals indicates it is not achievable. The North Mississippi Refuges Complex CCP established an objective of 440 acres of flooded bottomland hardwoods and 453 acres combined in flooded agricultural cereal grain and moist-soil vegetation. Based on a refinement of the habitat presently on the refuge, it can support 540 acres of flooded forest wetlands and 373 acres of agriculture and moist-soil habitat. Combined these habitats can support > 3.2 million duck-energy-days based on half of the acres being planted to corn or rice. The juxtaposition of the agricultural/moist-soil units to the green-tree reservoir allows waterfowl to fulfill other food resource requirements and sites for loafing and courtship behaviors. The refuge supports thousands of dabbling ducks including mallard, wood duck, and pintail each winter through these habitats. The refuge does not support any habitat for diving ducks or geese.

Breeding Wood Ducks

The wood duck is an iconic waterfowl species of North America. In the Mississippi Flyway the species represents the second most harvested duck. Wood ducks populations were decimated during the late 19th and early 20th century through market hunting and significant modifications to breeding habitat (Bellerose 1990). Within the MAV, agricultural clearing and commercial forestry has drastically reduced the natural availability of cavities for nesting. Dahomey NWR provides favorable breeding sites, with some natural cavities provided in relict cull trees, and good albeit limited brood rearing habitat. Additional brood habitat exists along the major drainages directly adjacent to the refuge.

Forest Interior Birds of Bottomland Hardwoods

The decline of many forest interior bird species is of major concern and the basis for much research and management activities within the MAV and other bottomland hardwood systems in the southeastern United States. Many of the identified species of greatest conservation priority are dependent on a complex understory and vertical structure within the hardwood forest of sufficient size to support viable source populations (Twedt et al. 1998). Priority bird species for the MAV include: the Swainson's Warbler, Cerulean Warbler, Prothonotary Warbler, Swallow-tailed Kite, Red-headed Woodpecker, Painted Bunting, Bell's Vireo, Northern Parula, Worm-eating Warbler, Kentucky Warbler, Orchard Oriole, Yellow-billed Cuckoo, Wood Thrush, and White-eyed Vireo (Twedt et al. 1998). Other than Red-headed Woodpecker, all of these species are Neotropical migrants wintering mostly or entirely in the West Indies, Middle America, and/or South America and breeding mostly in North America. In addition, temperate migrant species wintering in the MAV are American Woodcock and Rusty Blackbird should be considered as well. Though many of the identified species for the MAV are considered area sensitive to support healthy populations, the refuge at present would not be large enough for Swallow-tailed Kite and Cerulean Warbler, but has the future potential to meet these needs as it acquires additional landholdings expanding the central core of the Dahomey Bird Conservation Area. In addition, many of these species (e.g., Painted Bunting, Orchard Oriole, and White-eyed Vireo, in addition to some priority grassland species such as Dickcissel) occupy the early successional habitat provided by hardwood reforestation areas in artificially high densities at least temporarily only to collapse when the stem exclusion (mid-successional) stage is reached. Long-term conservation for many of these species will be tied to the range of structure within the mid-successional forest covering most of Dahomey today, even if supporting lower densities populations will persist for a much longer time.

The wetter and lower forested sloughs, where structure should be dominated by more open midstory and understory conditions, provides nesting habitat for some of the priority forest species, especially Prothonotary Warbler (but also wintering Rusty Blackbird). However, most of the highest priority forest interior species require more vertical and horizontal structure with dense patches of midstory and understory, which should dominate the forests less frequently flooded on higher ground. Of these species, Swainson's Warbler, Kentucky Warbler, and Wood Thrush are among those most likely to benefit from a more structurally diverse forest structure. While data are limited, these latter three species are rarely detected or are absent completely as breeding species from Dahomey, while species associated with more open understory and midstory are relatively common. Managing to support habitat conditions most suitable for maintaining Swainson's Warbler as the most area sensitive species now most likely to occur at healthy population levels would likely support most of the other species at Dahomey at higher densities (including others such as American Woodcock), but some of the presently common species (e.g., Prothonotary Warbler) may experience some reduction in densities while remaining relatively common.

Rafinesque's Big-eared Bat and Southeastern Myotis

Bottomland hardwood systems are important habitats for forest dwelling bats species (Taylor 2006). The reliance on this ecosystem is in part a function of the many niches (microhabitats) the system provides for bats of various species and life requisites. The loss of vast bottomland hardwood forested areas across the southeastern United States has significantly reduced the potential habitat for these bats. Within the MAV, this loss may exceed 80 % of the historic forested floodplain. As a consequence, it is generally acknowledged that certain forest bat species have declined as a direct result (Harvey et al. 2011). The Rafinesque's big-eared bat and southeastern myotis are two species that rely extensively on bottomland hardwood systems for roosting and foraging (Clark et al. 1998; Cochran 1999, Hoffman 1999, Stevenson 2008). Both species rely on large cavities within trees for diurnal roosting and maternal sites. Cypress and water tupelo with large basal cavities or upper internal cavities provide stable roosting environments (Clark et al. 1998, Rice 2009). In areas without major cypress or water tupelo breaks, other large diameter hardwood trees have been found to provide similar roosts (Stevenson 2008), however, these cavity trees can be limited at the local and landscape level. Both species are listed as species of special concern, and are state-listed as threatened or endangered within some other states across their range. The Service has an on-going status review to establish potential listing under the Endangered Species Act (Mike Armstrong, USFWS, Kentucky ES Office, Pers. Comm.). Dahomey NWR has potential to provide diurnal roost sites and foraging habitat for these species. A review of the habitat and occupancy by Rafinesque's big-eared bat and southeastern myotis on the refuge is being conducted (USFWS unpublished data, 2011). Initial results have been unable to detect either bat roosting in a sample of suitable basal cavities.

Black Bear

The black bear in Mississippi is listed as a State endangered species throughout its range. The Louisiana black bear subspecies (*Ursus americanus luteolus*) however, is federally listed as threatened (U.S. Fish and Wildlife Service 1995) south of Highway 82 in Mississippi. Dahomey NWR is 20 miles north of the federal designation zone and any bear occurring on Dahomey NWR would be classified as the state listed American black bear (*Ursus americanus*). Within the Delta, black bears have slowly begun to rebound in numbers. In part, this is a function of the dispersal of American black bears from Arkansas near White River National Wildlife Refuge. Bear sightings are becoming more frequent in the Delta along the mainline levee and have been observed within 3 miles of the refuge. As the bottomland hardwood forest on the refuge increases in age and structure to support large trees for denning as well as dense patches of understory for both soft mast and ground denning, and as additional lands are acquired to the west, the refuge will serve as an important linkage to existing populations and perhaps eventually support breeding bears.

Pondberry

Pondberry was listed as an endangered plant in 1986 (U.S. Fish and Wildlife Service 1993). The plant is typically associated with bottomland hardwood wetland systems that

receive periods of inundation into the growing season and is tolerant of a range of sun exposure from full shade to full sun. Protection of the species is primarily restricted to federal lands given the limited take provision afforded to plants in the ESA. Recovery of the species has been based primarily on protection and expansion of existing populations. Expansion of populations is difficult because the microhabitat conditions are very narrow and the plant normally reproduces by clones of lateral roots and only infrequently produces seed. Significant recovery populations exist within the MAV including Delta National Forest, which is south of Dahomey NWR. Another significant population of pondberry is located in Bolivar County on a Service conservation easement 15 miles north of the refuge. A limited survey for pondberry was done on Dahomey NWR during the initial acquisition period but no colonies were detected (Stewart 1990). However, the scope of the survey was restricted and many small populations may exist in an area of <100 square feet and therefore detection may be difficult. Stewart (1990) did indicate suitable habitat seemed to exist and did not rule out the possible occurrence. Furthermore, in the absence of an extant population but otherwise suitable habitat, an opportunity exists to reintroduce the species under a non-essential experimental population designation of the ESA.

Habitat Requirements for Resources of Concern

Migrating and Wintering Waterfowl

Waterfowl undergo several physiological processes that result in significant energy and nutrient demands while migrating or wintering in the MAV. Birds arrive as early as September (e.g., migrating blue wing-teal) and may stay on the wintering ground until early March. Therefore, resources need to be available over an extended period of 120-150 days to deal with changes in species and specific resource needs. Energy requirements during fall or spring migration are enormous and must be replenished daily to sustain long-distance flights. In addition, cold weather conditions can place significant increased energy demands which may affect migration. Finally, waterfowl undergo courtship and molt prior to and during spring migration which requires shifts in diets and habitat requirements. Collectively migrating and wintering dabbling ducks need a mosaic of habitat conditions consisting of shallow emergent wetlands with an abundance of moist-soil plants, shallow flooded bottomland hardwood forested areas, supplemental agricultural foods, and escape cover or sanctuary from disturbance (Reinecke et al. 1989).

The MAV provides this diversity of habitats across the vast landscape. The reduction of the forested system by 80% (Tiner 1984), has dramatically increased the importance of providing the habitat complex for wintering waterfowl on a very limited conservation footprint. Natural habitats that afford food and cover resources for waterfowl within the Delta consist of naturally flooded or irrigated bottomland hardwood forests and native emergent wetlands (i.e., moist-soil vegetation). Shallow flooded bottomland hardwood forest (<18 inches) provides food resources in the form of acorns, other soft mast, and aquatic invertebrates. These are heavily utilized when available by mallards, wood ducks and gadwall. The principle food resource within these areas is small acorns from Nuttall, willow, water, and certain other less common red oaks that are high in energy (Kaminski et al. 2003). Ducks also utilize other soft mass tree species like ash, maple, and

blackgum. Bottomland hardwood systems also provide an abundance of aquatic invertebrates within the litter layer and water column (Bateman et al. 2005, Heitmeyer 1988) which are critical to female dabbling ducks during late winter as they undergo the prebasic molt. Finally, forested wetlands provide important sources for thermal cover during extreme cold weather, and provide opportunity for isolation of birds for pair bond formation and resting (Reinecke et al. 1989).

Moist-soil habitat provides a 10-fold increase in food resource abundance in comparison to bottomland hardwoods (Strickland et al. 2010). These natural plant communities exist in areas of semi-permanent water that dry during the growing season and stimulate annual plant growth and seed production. When naturally or artificially inundated in fall and winter, dabbling ducks rely extensively on the seeds to meet energy demands (Fredrickson and Taylor 1982, Reinecke et al. 1989, Strader and Stinson 2005). The seed produced from smartweed, millet, sedges and many other moist-soil plants provide both energy and other nutrients often deemed deficient in cereal grains. Although moist-soil habitats have limited duck-energy days (~1800 DUD/acre), this habitat in connection with others provides the complex to support the nutritional requirements of foraging waterfowl.

Given the extensive reduction of bottomland hardwood forest and the limitation of the remaining to natural inundation due to flood abatement practices along the Mississippi River, the need exists to provide additional duck-energy day carrying capacity on a very limited area. Refuges and State wildlife management areas, and to a much lesser extent private land holdings, can meet goals of the NAWMP only through provision of flooded agricultural grains (corn, milo, rice, millet). These high-energy foods are rich in carbohydrates and greatly exceed energy availability compared to natural food resources.

As previously mentioned, waterfowl during winter are subject to increased energy demands as a function of weather, disturbance from hunting, and other behavior aspects related to courtship and prebasic molt. Limitations to direct disturbance reduce energy demands and interference with other physiological and behavioral functions. Providing opportunities for waterfowl to have access to sanctuary is especially important during the latter portion of the wintering period when food resource abundance is more restrictive and birds are engaged in pair bond formation and prebasic molt.

Breeding Wood Ducks

Wood ducks require two major habitat components to sustain populations: suitable nest sites in the form of natural cavities or artificial nest boxes; and wetlands to provide abundant food resources for brood rearing, concealment from predators, cover from extreme weather, and loafing sites (Bellrose and Holm 1994). The reliance on cavities for nesting makes this species unique among North American waterfowl species.

Within Mississippi bottomland hardwood forested systems, suitable natural cavities have been found to be limited (Lowney and Hill 1989, Lee 1991) and nest box programs may serve as a means to support and expand local wood duck production. If nest box programs are utilized to supplement natural cavities, these should be erected in direct proximity to slow moving rivers and streams with abundant vegetative cover along the

banks, scrub-shrub swamps/sloughs, and other wetlands with an abundance of aquatic invertebrates. These areas will provide important brood rearing sites during the first 2-4 weeks when brood survival is most negatively affected (Bellrose and Holm 1994). An interspersed of shallow flooded scrub/shrub (e.g., buttonbush and herbaceous plants) and some open water provides suitable brood cover. Protection of nest boxes by installation of a metal shield below is necessary to prevent recurring depredation of nests and hens from raccoons and snakes. After wood duck broods have reached flight stage, dietary shifts begin to influence habitat use. Birds utilize more natural seed production and by fall rely heavily on hard mast when acorns are shallowly flooded in fall and winter. The retention of shallowly flooded emergent wetlands and forested areas into early spring provides important microhabitats for aquatic invertebrates which are critical to female wood ducks during egg laying.

Forest Interior Birds of Bottomland Hardwoods

As a group, the forest interior birds are an extremely diverse taxon. Within the MAV bottomland hardwood forest, well over 100 species can be found including hawks, owls, passerines and many Neotropical migratory species. Many of the species are resident, while others migrate to the tropics each year and return either to breed or utilize the area as a temporary stop-over for migration. Because of the high bird species richness within the forested landscape, the habitat requirements for them can be equally diverse. Small separations between niches allow species to minimize competition and coexist. Habitat conditions for some species may conflict with the needs of other species and a critical understanding of habitat requirements for each species is necessary for balancing habitat management that takes into account the majority of these species. Therefore, presumed habitat conditions may not be ideal for all species in space and time and changes in individual species populations may be dynamic in response to habitat modifications. Many of the high priority species identified in the Partners in Flight program (Twedt et al. 1998) tend to favor areas for breeding with a higher component of understory and midstory vegetation, often associated with older forests that historically were maintained through a series of regular large treefall gaps ("gap phased dynamic") that is very rare in the MAV today. As an example, Swainson's Warbler and Kentucky Warbler territories tend to be associated with giant cane and other dense vegetation.

Thus, management activities which open the forest canopy may subsequently create favorable breeding sites for these species (Thatcher 2007, Twedt and Somershoe 2009). However, stand thinning was also found to at least temporarily reduce the densities of other species associated with more open understory and midstory such as with Prothonotary Warblers (Heltzel and Leberg 2006) and other birds (Twedt and Somershoe 2008). Larger treatments produce negative effects on some forest interior and canopy dwelling songbirds (Pashley and Barrow 1993). With these concerns in mind, in each case study the results need to be kept in perspective with an understanding that the higher priority species were previously absent or very rare and treatments to a varying degree led to increasing numbers, but with densities for these higher priority species still far below the post-treatment densities of species like Prothonotary Warbler and Acadian Flycatcher that remained relatively common in most applications.

Thus, the magnitude of the shift in species and the viability of populations need also to be considered with regards to habitat treatments. For example, Twedt and Somershoe (2009), documented responses of bottomland hardwood species at Tensas River NWR (with forest conditions largely comparable to those at Dahomey) to ongoing forest management that applied variable retention management (as recommended in LMVJV 2007) in stands ranging from 1 to 12 years since treatment compared to untreated stands. Twedt and Somershoe then modeled the results to show relatively dramatic increases in Swainson's Warblers from a detection rate of near zero per 10-minute point count to over 0.2 detections after 13 years post disturbance. In contrast, Prothonotary Warbler in these same stands went from about 1.0 detection per 10-minute point count to 0.5 detection rate 7 years after treatment and then back to over 1.0 after 13 years. At no point were lower priority species associated with more open midstory and understory at risk of being lost from treated stands or even reduced from being considered relatively common compared to the higher priority species dependent upon greater understory and midstory structure (the latter again were mostly absent or very rare in untreated stands).

At a more refined approach, Benson et al. (2011) determined that large-scale habitat classification for Swainson's warbler led to misinterpretation of suitable nesting habitat and grossly over-estimated potential carrying capacity within existing forested wetlands in the MAV that were dominated by lower elevation and wetter forests such as at White River NWR where the study was conducted. In contrast, Dahomey NWR is one of the few remaining forest patches today that is dominated by infrequently flooded higher ground and therefore is optimal for producing a relatively large Swainson's Warbler population on the existing 8,100 forested acres, and even more so with additional reforestation on more recent and future acquired lands. This latter point is particularly important with respect to smaller forested areas (i.e., less than 10,000 acres) within heavily fragmented landscapes, such as that presently surrounding Dahomey. Fragmentation from agricultural landscapes, roads etc., may increase brown-headed cowbird parasitism, nest depredation, and ultimately reduce adult/young survivorship in stands initially treated, but this effect is reduced over time and would be less of a problem with the additional forested acreage at Dahomey increasing to over 10,000 acres, and complimenting any forest management intended to increase forest habitat quality.

Rafinesque's Big-eared Bat and Southeastern Myotis

The principle habitat component which can readily be evaluated for Rafinesque's big-eared bat and southeastern myotis is their reliance on tree cavities for roosts. Though there is extensive knowledge about roosting by both species in man-made structures and caves in the northern portion of their range, the only natural roosting habitat for these species in the MAV is within bottomland hardwood forests.

Most work on the roosting of the species has documented occupancy in bald cypress and water tupelo (Clark et al. 1998, Gooding and Langford 2004, Rice 2009). In these studies the research limited searches to within cypress and tupelo breaks and therefore did not examine other potential hardwood species. However, in areas with a mixture of other

hardwood trees or the absence of cypress and water tupelo, occupancy has been documented in an American sycamore, swamp chestnut oak, sweetgum, blackgum, and hickory (Cochran 1999, Trousdale and Beckett 2005, Stevenson 2008).

In general, all published works indicate the use of trees with large diameters which correlates with large interior chamber widths. However, within a mature bottomland hardwood forest in Mississippi, Stevenson reported roosting in trees with a minimum DBH of 16 inches and chamber heights >6 feet, but critically important maternal roosting was restricted to relict bald cypress trees with significantly larger DBH (>36 inches). In addition, the frequency of switching diurnal roosts (Trousdale and Beckett 2005) indicates the need to have multiple suitable roosts scattered across the home-range of the species. Finally, Rice (2009) and Stevenson (2008) reported the abandonment of warm season roosts to trees used exclusively during winter months. The cavity characteristic switched from basal cavities to top entrance cavities. This finding suggests that a much greater diversity of tree cavities is needed to support the both species. Retention of the oldest trees and not necessarily the largest within the forest may be necessary to achieve physiological characteristics within the tree to develop these cavities. At present, there is no understanding of how bats utilize habitats around roost sites for foraging, so caution is warranted with respect to manipulating stand structure around known or suspected maternity roosts. However, most known roosts are within bald cypress or tupelo trees that are usually within passively managed buffers already. It is possible that adjacent agricultural fields to the refuge and more diversified structure within stands may provide suitable foraging habitat at least for Rafinesque's big-eared bat, while sloughs and river edges may be most important for southeastern myotis.

Black Bear

The refuge supports or could support habitat for recovery efforts for the State listed black bear and connectivity with the listed subspecies range to the south. Given the large home-range of black bear, habitat management for the species includes ensuring habitat and corridors to other sites with reduced rural/urban interface (Young 2006). Broadly defined, expanses of relatively inaccessible terrain, thick understory vegetation, abundant hard and soft mast foods, and den sites (BBCC 2005) are ideal habitat conditions.

Black bears are omnivores and have a broad diet comprised mostly of vegetation (Pelton 2000, Black Bear Conservation Committee 2005, Benson and Chamberlain 2006). Diet is dictated by season, with herbaceous vegetation, berries, fruits and insects used during the spring and summer. In fall, bears switch to soft mast and acorns and will utilize agricultural crops in the summer and fall if available. This provides important resource for "hibernating" bears in winter. The need to increase body fat prior to winter may force bears to disperse long distances in search of high energy foods.

Within Mississippi, a potential factor affecting bear population increases is the availability of dens. These sites are used during winter months. Both males and females use ground dens but greater protection can be provided in tree cavities where females will remain all winter with cubs. Large diameter hollow cypress, oak, sycamore and

sweetgum are uncommon on the landscape and may determine seasonal habitat use by bears (U.S. Fish and Wildlife Service 1995, Weaver and Pelton 1992).

Forest management that increases availability of soft mass most often associated with canopy gaps (that can also provide more ground denning opportunities along with dense canebrakes), increases the persistence of oaks for hard mass, and retains the largest live trees and snags also for denning is considered most appropriate for supporting resident bear populations (LMVJV 2007). Forest management is considered consistent with the needs of the Louisiana black bear subspecies to the south of the refuge, as established by the Louisiana Black Bear Recovery Plan.

A second factor affecting bear populations in Mississippi is the degree of habitat fragmentation. Black bears use a variety of forested habitats within the state of Mississippi, with the southern population designated as federally endangered (U.S. Fish and Wildlife Service 1995) and the remainder of bears listed as State Endangered. The largely agricultural landscape has limited value to black bears and makes them more vulnerable to vehicle strikes as they move between forest blocks. Habitat management which links areas from source populations in Louisiana and Arkansas to forested areas east of the batture will provide long-term conservation for the species.

Pondberry

In Mississippi, pondberry occurs in bottomland hardwood forests exclusive within the Delta. Suitable habitat seems to exceed the distribution of the known colonies which tends to be associated with areas subject to frequent 2-3 year flooding. However, across the species range, there is great variability in site specific conditions (U. S. Fish and Wildlife Service 1993). Areas adjacent to intermittent wetlands with partial to complete shade provide site conditions for the plant. The plant is highly restricted across its range and believed to have always been rare and uncommon. The near elimination of much of the forested MAV and extensive draining of the associated wetlands have fragmented and likely genetically isolated colonies. Habitat management for the species relies on retention of existing wetland conditions around colonies. Protection from ground disturbance of any kind (e.g., removing overstory, destruction from wild pigs) and loss natural wetland cycles are major threats. Opportunities for direct reestablishment are still being reviewed and considered as a viable recovery action (U.S. Fish and Wildlife Service 1993).

IV. HABITAT MANAGEMENT GOALS AND OBJECTIVES

Habitat management goals and objectives were developed from the North Mississippi Refuge Complex CCP. A goal expresses a broad, qualitative statement that supports the establishing purposes and vision of the refuge. The step-down objectives are quantitative statements which provide more specific, measurable and time sensitive habitat direction for accomplishing the goals. The goals in the CCP were created to cover the 3 refuges and FSA properties administered by the complex and based on wildlife populations rather than the habitat. Therefore, it was necessary to modify the goals to more appropriately reflect the habitat for Dahomey NWR while still retaining the intent of the goals in the CCP. This allowed for more specific objective(s) from the CCP to be expanded upon or combined addressing the Resources of Concern identified in the HMP (**Section 3.0**). Below each objective are the primary Resources of Concern and a Rationale for how this supports the Objective or Goal. In order to be responsive to meeting goals and objectives, it is important to evaluate progress on a recurring basis and alter strategies as appropriate (Adaptive Management). Therefore, Adaptive Management Monitoring Elements are identified for evaluation of habitat and wildlife response. Inventory and monitoring of wildlife species will be larger than those specified based on a station level inventory and monitoring plan.

4.1 Moist Soil Habitat Goal

Protect, enhance, and where possible restore the ecological integrity of bottomland hardwood habitat to support migratory birds, endangered and threatened species, and other fish and wildlife resources representative of the Mississippi River Ecosystem (CCP Goals 1, 3, and 4 combined, pages 60, 78, 80).

Objective 4.1.1:

Manage Units 9, 10, 11, 12, 30, and 40 (373 acres) in agricultural/moist-soil plants to provide a minimum of 3.3 million duck-energy-days (minimum of 165 acres at 20,000 DED/acre) available beginning November 15 through March 15 in support of wintering waterfowl goals developed by the Lower Mississippi Valley Joint Venture (LMVJV) (CCP Objective 1-1, 4-1).

Resources of Concern: Migrating and wintering waterfowl, breeding wood ducks

Rationale: Goals and objectives to support average fall flights of winter waterfowl in the MAV were established in the NAWMP and subsequently stepped-down at the local scale through the LMVJV. The food resources to support the necessary duck-energy-days of waterfowl on a 90-120 day period are predicated on state and federal conservation areas providing intensively managed habitats (i.e., agricultural cereal grains/moist-soil). The objectives established for the refuge are based on a cooperative farming program and the majority of the DED being comprised of unharvested cereal grain. Moist-soil management, if

undertaken, will promote preferred annual plants used by waterfowl.

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Acres of unharvested grain flooded • Acres of Moist-soil managed within units • Plant composition in Moist-soil Managed Units 	Monitor Method <ul style="list-style-type: none"> • GIS mapping (Annual) • Ocular % plant species Composition (Annual – Fall)
Wildlife Response Variables <ul style="list-style-type: none"> • Winter waterfowl occupancy 	<ul style="list-style-type: none"> • Waterfowl counts (1-2/month Nov 20-March1)

Objective 4.1.2

Manage a portion of Unit 45 (approximately 540 acres) as a green-tree reservoir and minimally flood the unit every other year from December 1 through March 1 to provide food resources, cover, and sites for pair formation in support of wintering waterfowl habitat goals developed by the Lower Mississippi Valley Joint Venture (LMVJV) (CCP Objective 1-1).

Resources of Concern: Migrating and wintering waterfowl, breeding wood ducks

Rationale: The availability of naturally flooded bottomland hardwood forest in winter within the MAV has been drastically reduced as a result of permanent land conversion to agriculture, short-rotation commercial hardwood management, and massive flood abatement projects. Green-tree reservoirs provide a means to mimic similar habitat conditions to support migrating, wintering and breeding waterfowl resource needs on a more structured time interval (Fredrickson and Bateman). Waterfowl will benefit from these wetlands along with other non-game wildlife.

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Acres of flooded hardwood • Water level by date 	Monitor Method <ul style="list-style-type: none"> • GIS mapping of perimeter • Staff gauge
Wildlife Response Variables <ul style="list-style-type: none"> • Winter waterfowl occupancy 	<ul style="list-style-type: none"> • Waterfowl counts (1-2/month January 1-March 1)

Objective 4.1.3

Maintain and promote the development of upper canopy cavities for wood ducks within all mature hardwood Units, retain wetland conditions favorable for brood rearing in Units 14, 18, 46, 47, 48 and other ephemeral wetlands through July, and provision 20 artificial wood duck nest boxes near the brood habitat (CCP Objective 1-2).

Resources of Concern: Breeding Wood Ducks

Rationale: The limited availability of natural cavities for wood ducks to nest has been well documented in the MAV (Lowney and Hill 1989, Lee 1991). Local populations of wood ducks and hooded-mergansers can be enhanced dramatically by providing appropriate brood habitat and artificial nest structures.

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Canopy level cavities • Acres of wetland • Number of artificial boxes 	Monitor Method <ul style="list-style-type: none"> • Cavity Estimation (1/10 year) of sample of Refuge stands • GIS mapping of wetlands (Annual) • Count of available nest boxes
Wildlife Response Variables <ul style="list-style-type: none"> • Wood duck production 	<ul style="list-style-type: none"> • Nest checks (1-3 times/season) – Production estimate

Objective 4.1.4

During the next 15 years at least 35% of Management Units (1, 4, 13, 23, 24, 27, 37, 38, 44, and 45) should be managed to contain a diverse assemblage of both hard mast and soft mast producing hardwood species characterized by averages of 60 – 70% overstory canopy cover, 25 – 40% midstory cover, and 60 – 70 ft²/acre basal area (with over 25 % in older age classes as defined as those stems approaching biological senescence using species-site-size relationships as a surrogate for judging tree age), along with retention of most snags and potential denning trees (for Rafinesque's big-eared bat, black bear, etc.; CCP Objective 3-2, 4-2) to meet the Desired Forest Conditions as developed by the LMVJV Forest Resource Conservation Working Group (2007). Establish appropriate buffer zones around sloughs and otherwise where potential Rafinesque big-eared bat and southeastern myotis roost trees are now found

Resources of Concern: forest interior birds, black bear, Rafinesque's big-eared bat and southeastern myotis, breeding wood ducks.

Rationale: None of the compartments met any DFCs at the compartment scale, with 30 percent of the forest considered in need of immediate management and an additional 67 percent also in need of management, especially in that all these stands exceed basal areas of 90 ft²/acre (Smith and Sansing 2008). The loss of mature bottomland hardwood forests and their associated wildlife species have been irrevocably affected both in population and distribution. Given the anticipated demand for agricultural products derived from areas within the MAV, the acreage under commercial forest management, and the acreage of extant bottomland hardwood forests within the MAV, it is inconceivable that any appreciable large forest blocks will be set aside in the vicinity of Dahomey NWR within the private sector for conservation/management as the primary objective. Therefore Dahomey NWR plays a critical role in this portion of the Mississippi Delta. While this objective does incorporate active management, such active management is intended to mimic conditions that were well represented in what used to be old-growth conditions in the MAV and can be compared to control areas by carefully monitoring for response by a diversity of native species, including forest interior birds, forest bats, and other species associated with mature bottomland hardwood forests.

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Cane distribution and density • Basal area • Overstory composition and canopy cover • Midstory composition and canopy cover 	Monitor Method <ul style="list-style-type: none"> • GIS mapping (5-10 year interval) • 10-year monitoring of stands using standardized forest inventory metrics (BA, species, % canopy closure, cane density, regeneration) • CFI Plot – 20 year interval
Wildlife Response Variables <ul style="list-style-type: none"> • Forest interior bird presence and abundance • Bat use of basal cavities • Bat occupancy of area • Bear sightings 	<ul style="list-style-type: none"> • Standardized breeding bird survey points (2-4 year sampling interval) • Repeated checks of permanently marked sample trees (2-3 times June-Sept) • Bat Acoustical Survey (3 time/year June-Sept, 1 time in January/February)

Objective 4.1.5

In Management Units (3, 7, 8, 15, 17, 19, 20, 21, 22, 25, 26, 28, 33, 34, and 36) evaluate the success of reforestation over the next 10 years and implement the LMVJV Forest Resource Conservation Working Group's Desired Forest Conditions on at least 35% of the reforested acreage. Desired conditions are to include a diverse assemblage of both hard mast and soft mast producing hardwood species characterized by 60-70% overstory canopy cover, 25-40% midstory cover, and 60-70 ft²/acre basal area (with over 25% in older age classes; CCP Objective 4-2).

Resources of Concern: forest interior birds, Rafinesque's big-eared bat and southeastern myotis, black bears.

Rationale: The reforestation of agricultural units is one of the most important strategies to improving the overall ecological integrity of bottomland hardwood ecosystems. Reforestation reduces habitat fragmentation, establishes linkages to other forest blocks thereby increasing the potential to support viable populations and a means of population expansion of threatened and endangered species (black bear) or species of special concern (Rafinesque's big eared bat and Southeastern myotis). To speed development of these stands into functioning bottomland hardwood forest, the LMVJV Forest Resource Conservation Working Group (2007) recommends management towards the above mentioned desired forest conditions should be strived for the majority of forest under active management, recognizing that logistically no more than 35-50% of stands on the landscape are likely to meet those conditions at any given point in time.

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Overstory canopy cover • Midstory canopy cover • Basal area • Species composition 	Monitor Method <ul style="list-style-type: none"> • GIS mapping (5-10 year interval) • 10-year monitoring of stands using standardized forest inventory metrics (BA, species, % canopy closure, cane density, regeneration) • CFI Plot – 20 year interval
Wildlife Response Variables <ul style="list-style-type: none"> • Forest interior bird presence and abundance • Winter woodcock presence 	<ul style="list-style-type: none"> • Standardized breeding bird survey points (2-4 year sampling interval) • Transect flush counts (Annual)

Objective 4.1.6

In all forested, reforested, or permanent wetland Management Units maintain or restore the natural hydrology to the unit through the elimination of artificial drainages and other alterations to the hydrology and the prevention of water retention of >5 acres during the growing season within hardwood areas (CCP 4-2, 2-2).

Resources of Concern: interior forest birds, Rafinesque's big-eared bat, southeastern myotis, pondberry

Rationale: This objective is fundamental towards achieving restoration for the ecological integrity of the bottomland hardwood system at the Refuge level. Microhabitat conditions determine plant response and presently may limit the potential for pondberry. Many species of indigenous wildlife and interior forest birds would benefit from the increased understory and midstory vegetation which would become established in areas of a higher moisture gradient. Water quality has also been an issue on the refuge through excessive siltation within wetlands. Preventing water retention on a large scale into the growing season would eliminate major overstory tree mortality.

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Linear feet of artificial drainages • Number of artificial drainages • Acres impounded by beaver dams in spring • Contaminant levels 	Monitor Method <ul style="list-style-type: none"> • GIS – inspect each field border and map length as base (annual report reduction in length and number) • GPS locations – annual GIS database • Contaminant level determination in soil sediments of wetlands – 10-20 year interval
Wildlife Response Variables <ul style="list-style-type: none"> • Pondberry Occurrence? • Number of beaver dams 	<ul style="list-style-type: none"> • Systematic survey of suitable habitat (1 time – February-March) • Dam counts at structures

4.2 Land Acquisition Goal

Acquire the 2,210 acres within the Dahomey NWR acquisition boundary to support linkages of forest blocks needed to support the protection and restoration of fish and wildlife resources within the Mississippi River Ecosystem (CCP 5-1)

Objective 4.2.1:

Initiate a program to identify and secure sources of funding to acquire the 2,210 acres of land base within the approved 11,600 acre acquisition boundary for Dahomey NWR during the next 5 years.

Resources of Concern: Migrating and wintering waterfowl, forest interior birds, Rafinesque's big-eared bat and Southeastern myotis, black bear

Rationale: The existing fee title holdings for Dahomey NWR are marginal or insufficient to support viable populations of priority Neotropical migratory birds, and limits potential habitat for other Resources of Concern. The additional land base will significantly reduce habitat fragmentation and achieve the Dahomey BCA core of sufficient size to support viable bird populations of high conservation priority. The objective also supports a means of linking forest blocks together supporting metapopulations of other species (bears, bats).

Adaptive Management Monitoring:

Habitat Response Variables <ul style="list-style-type: none"> • Habitat classification of acres in acquisition boundary • Acres acquired • Method of acquisition 	Monitor Method <ul style="list-style-type: none"> • GIS cover mapping based on county level aerial photography. 1/10 years • GIS Map Acres acquired annually • CFI Plot – 20 year interval
Wildlife Response Variables <ul style="list-style-type: none"> • To be determined based on management potential after acquisition of lands 	<ul style="list-style-type: none"> • To be determined

5.0 HABITAT MANAGEMENT STRATEGIES

Habitat management strategies are specific treatments or actions to be accomplished singularly or in combination to achieve goals and objectives. In many cases, strategies will be dynamic based in part on resource constraints, timing considerations, weather, or other unforeseen circumstances. Therefore adaptive management will be a standard approach as strategies fail to meet objectives or alternative approaches are developed which may enhance objective outcomes.

5.1 Agricultural/Moist-soil Management Strategies

5.1.1 Potential Strategies

The basis for meeting migrating and wintering waterfowl food resource needs is through the provision of high energy seeds and protein (invertebrates). This can be done by providing natural foods or supplementing them with agricultural cereal grains. If the objective of Duck-Energy-Days is established, then one can achieve the value by an interaction of the acres under agricultural production or in moist-soil management.

Moist-soil management can provide relatively good plant response to achieve seed production used by foraging waterfowl. However, the total Duck-Energy-Days associated with moist-soil plants is only 1800 DED/acre in comparison to unharvested agricultural grains (corn, rice, and milo) which can exceed 20,000 DED/acre. Therefore, large aggregations of migrating and wintering waterfowl can only be supported on either very large areas under moist-soil management or much fewer acres under going intensive cereal grain production. Given the habitat present at Dahomey NWR, the stated objective can only be met through the majority of the available acres being planted in agricultural crops.

Moist-soil management refers to management that provides moist conditions during the growing season which promotes the growth of heavy seed producing annuals, such as wild millets, smartweeds, sprangletop, other grasses and sedges. The strategy is based on manipulating soil moisture and periodic disturbances (Fredrickson 1991, Strader and Stinson 2005). The quality of production is in part determined by timing and rate of dewatering units, soil disturbance, the stage of plant succession, and the timing and rate of reflooding. Though moist-soil plants exist within natural wetland areas, intensive management for them can be achieved within impounded units that have water control capabilities (Units 9-12). Soil disturbance and moisture are critical for the production of these desirable plants. Failure to disturb the soil (i.e. disking) allows the natural progression to a perennial plant community and reduces waterfowl DED and usage. In some circumstances production of undesirable broadleaf plants (cocklebur and coffeeweed) may occur and require shallow overtop flooding or selective herbicides to kill the plants and allow grasses and sedges to respond.

The variability of drawdowns in (April-August) and subsequent reflooding of units in fall (October – December) provides for a greater diversity of plant development and makes food resource available across the fall and winter migratory and wintering period. In units with significant relief, staggered flooding of the unit over several weeks or months

may be necessary to allowing duck access to food resources since dabbling ducks forage in water <18 inches (Unit 30 and 40).

Intensive agriculture production of cereal grain provides a means of providing large amounts of food resources needed to support thousands of migrating and wintering waterfowl on a relative small area. The refuge has both limited personnel and no equipment to support a force-account farming program at this time. Therefore, intensive grain production can best be achieved through the continuation of a cooperative farming program. Under this arrangement, a local farmer enters into an annual lease agreement with the Service to grow cereal grains. In exchange for the use of the land, the farmer returns payment in the form of a $\geq 25\%$ share of the produced acres left unharvested in designated fields. Typically, 160-185 acres of unharvested crops is made available. The Service can set restrictions on crops planted and rotated, pesticide and herbicides used, and other considerations for farming. This process has been instrumental at Dahomey NWR for production of food resources for migrating and wintering waterfowl. A recent review of the refuge farming program, as well as new guidance from the Washington office, brought to light some discrepancies in the administration of the program, which need to be resolved. These issues include: all acres included in the base acreage must be farmed at least every other year; if genetically modified seed is used, crops must be rotated or a non-genetically modified strain must be used at least every fourth year.

Units 30 and 40 have been surrounded by a horseshoe levee to impound water pumped from 2 separate wells. Annually, temporary levees have been constructed to partially flood the units. In addition, Units 5 and 6 are on a higher ridge and have no immediate ability to provide flooded food resources; these units are typically held by the cooperative farmer for their share of the crop. Therefore, the Refuge potential to provide floodable acres of agricultural/moist-soil habitat for waterfowl is presently 373 acres.

5.1.2 Management Strategy Prescription for Agricultural/Moist-Soil

To meet **Objective 4.1.1** for migrating and wintering waterfowl, the following strategies will be used to manage agricultural/moist-soil habitat:

- Use a single cooperative farmer to cultivate up to 615 acres of existing fields to provide a share of 160-185 acres of unharvested crops.
- Cooperative farmer must plant Units 30 and 40 in corn, rice or milo in conjunction with any other field acreage. The lowest relief of units 30 and 40 should be used as the share-crop portion for the Service and left unharvested.
- Review and approve pesticide usage and have farmer create a minimum of 50 - foot buffer along drainages and field borders.
- Utilize Best Management Practices to minimize siltation and pesticide run-off.
- Dewater areas to be cooperatively farmed so soil conditions are tillable by April 1 (March 1-15).
- Plant corn by April 15, rice by June 1, and milo no later than July 15.
- In the absence of a contract with a cooperative farmer, manage units 9-12, 30 and 40 for moist-soil. Units 5 and 6 would be left fallow.

- If moist-soil plant production is poor due to soil moisture problems, broadcast with 20-25 lbs/acre of Japanese millet or browntop millet between July 15 and August 30. Evaluate the need to control fall army worm during the first 1-3 weeks post-germination. Control as necessary with an approved pesticide.
- Stagger dewatering of units being managed for moist-soil beginning no sooner than May 1.
- If a unit or major portion of a unit is covered by > 30% pest plants (e.g., coffeeweed) utilize a selective broadleaf herbicide (e.g., Blazer).
- Based on moist-soil plant response, anticipate disking units not in a cooperative farm lease every 2-3 years to promote annual plants.
- Stagger flooding of units beginning November 1 using the wells so that units 30 and 40 are at full pool by November 20th. The remaining units (9-12) should be brought to full pool by January 1.
- Create permanent cross levees near the two wells in Units 30 and 40 to facilitate distribution of the water into the units.
- Evaluate the need of a waterfowl sanctuary to support large concentrations of waterfowl in an undisturbed area of the refuge through road closure or restricted/reduced public waterfowl hunting.
- If the Service abandons cooperative farming and initiates force-account farming for agriculture/moist-soil, evaluate reforestation of Units 5 and 6 since these areas would not be needed to support the wintering waterfowl population goals.

5.2 Green-tree Reservoir Management Strategies

5.2.1 *Potential Strategies*

The MAV was historically a large forested wetland which flooded annually during midwinter and spring. The area provided a vast expanse of habitat conditions for migrating and wintering waterfowl, especially mallard and wood duck (Fredrickson and Heitmeyer 1988, Reinecke et al. 1989). However, in the absence of natural flooding, one can emulate flooded bottomland hardwood to provide food resources, weather protection, and sanctuary for behavioral pair formation of waterfowl (Fredrickson and Batema). These artificially flooded hardwood areas are referred to as green-tree reservoirs (GTR). The principle function of the GTR is to provide migrating and wintering waterfowl access to acorns and invertebrates. Secondarily these areas provide protection during inclement weather, and sites for behavioral pair formation. The importance in GTR management is to insure water is not retained prior to fall senescence of trees (November) and removal of the water soon after leaf-out (April 1) to prevent canopy tree mortality.

The 540-acre GTR at Dahomey NWR exists within a shallow portion of Unit 45. The potential strategy for the unit is to flood every year or on alternate years to provide a balance of resource needs to wintering waterfowl. Water levels can be manipulated through two large stop-log structures to maintain an area of water constantly at <18 inches. Slowly raising the water in fall and dewatering in early spring provides a continuous exposure of new habitat at preferred foraging depth.

5.2.2 Management Strategy Prescription for Green-tree Reservoir

To meet **Objective 4.1.2** in management Unit 45 (~540 acres floodable) for migrating and wintering waterfowl, and breeding wood ducks, the following strategies will be done:

- Install 2-3 feet of riser boards in mid-November in each pipe.
- Depending on winter rains, slowly increase GTR impoundment by 6-inch increments every 1-3 weeks.
- Bring to full pool by January 15.
- Lower water on a similar schedule with all water removed by April 1.
- After April 1, check water control structure every 1-3 weeks to insure beavers have not clogged the pipe and caused retention of water during the growing season.
- Trap beaver as necessary in spring to retain water control capabilities of the structures.

5.3 Forest Wetland Protection and Restoration Strategies

5.3.1 Potential Strategies

Though the bottomland hardwood system of the MAV is defined as a forested wetland, the time period in which the area is flooded is of particular concern. Excessive water retention during the growing season can lead to large scale mortality. This loss may be acceptable on small acreages (e.g., <10 acres) distributed across the landscape and over an extended time period. It would create natural openings for regeneration and microhabitat favorable for breeding wood ducks and many other species. On the refuge, this retention of water would normally be attributed to beavers clogging roadside ditches or other drainage pipes within the bayous. In most cases, selective removal of the dams would be done in early spring to prevent flooding into the growing season.

Restoration of the ecological integrity of the bottomland hardwood forest on the Refuge will never be fully possible. However, restoration of local wetland conditions can be improved throughout the Refuge through a process of filling artificially created drainages and ditches. Most of the agricultural fields on the refuge which have subsequently been reforested to date had drainages created along the edges to facilitate drying of soils in early spring. This has reduced the microhabitat conditions in many areas and thus influenced the understory vegetation and wildlife response. The strategy to restore some of the localized wetlands is based on plugging the outlet of drainages and evaluating restoration potential of channelization and dredging done on or adjacent to the major bayous. In the absence of any restoration efforts, many of the microhabitat conditions are unlikely to be restored or enhanced.

Finally, Stokes and Bellman Bayous serve as primary drainages for agricultural fields north of the Refuge. Heavy loads of siltation and agricultural pesticides flow through the refuge as a result of these farming programs. Efforts to limit siltation and restricted use pesticides into the bayous could dramatically improve water quality.

5.3.2 Management Strategy Prescription for Forest Wetland Protection and Restoration

To meet Management **Objective 4.1.6** across all habitat Units, the following strategies will be used to protect, enhance or restore natural hydrology:

- Identify artificial drainages along reforestation areas, map locations and include in the refuge GIS system.
- Remove any unnecessary culverts along roads and allow water to naturally disperse, which serves as means to minimize siltation.
- Fill identified artificial drainages within reforested areas or other units by plugging the head of the ditch with on-site soil.
- Minimize ditch pulling with the road grader as a standard maintenance practice to decrease the rate of draining areas.
- Identify beaver impoundment areas and GPS locations by the end of March.
- Selectively remove only those dams that inundate >5 acres of forested area by May 1 or those that are associated with agricultural/moist-soil units by March 15.
- Trap beaver at selective sites in order to minimize recurring water impoundment at targeted locations (i.e., water control structures)
- Evaluate the potential of partial or full wetland restoration efforts across the refuge by examining topographic maps for natural contour depressions.
- Limit use of only approved pesticides on the Refuge to maintain water quality.
- Support and encourage efforts by adjacent landowners to utilize Best Management Practices to limit siltation by reinstallation of riser boards in late fall. This will prevent erosion and limit weed development.

5.4 Bottomland Hardwood Forest Management Strategies

5.4.1 Potential Strategies

Management actions (strategies or treatments) which effectively reduce the overstory canopy greatly influence the wildlife and vegetative communities within bottomland hardwood systems. The degree of the treatment (% removal), size of area, spatial configuration and temporal scale have significant influences and determine to some degree the anticipated outcome of the resources of concern being monitored. In addition, the strategy to meet the goals and objectives needs to be understood at a larger scale and its singular or cumulative effects on resources considered before implementation. The goals and objectives of the Dahomey CCP and Resources of Concern established for the HMP are not independent. Rather, efforts to promote one resource over the other may have positive, negative, or no effect on others.

The absence of any silvicultural treatments is likely to result in no appreciable change in avian diversity (species richness, abundance, and density). At the same time, to increase species richness and favor some species which are currently rare or absent from the refuge, treatments should be applied at key times as defined by the “Desired Forest Conditions.” However, before taking any action, it is important to know the current condition of each stand. Therefore the first step in the process of management of these

forests will be evaluating the stand condition, followed by selection of which stands are most in need of manipulation, using the latest inventory information (Smith and Sansing 2008). If any of the following conditions are met, then management is warranted: overstory canopy cover >80%; midstory cover <20% or >50%; or tree stocking is <50% or >90%, and/or basal area >90 ft²/acre.

Shifts in tree composition may occur over time, but there is little certainty as to what effect, if any, these changes are having on these species. An active management strategy can and would promote advancement in the ecological integrity of an area when done in conjunction with other initiatives. This action would also develop characteristics often associated with old-growth conditions within the forest. Presently, the bottomland hardwood forest on the refuge is ecologically very young (60-80 years old on average) having been significantly altered through a series of clear cuts and high-grading from 1969—1983. The oldest stand dates to the late 1930's.

5.4.2 Management Strategy Prescriptions for Bottomland Hardwood Forest

To meet **Objectives 4.1.3 and 4.1.4** in bottomland hardwood forest units, the following strategies will be done:

- Reclassify stand boundaries (management units) based on current aerial photographs and field verification – presently stand boundaries for several units are too big and do not represent discernable biological differences of stands.
- Based on the reclassified units, overlay forest inventory plot data from the 2008 forest inventory, and develop a GIS layer with standardized plot data metrics (e.g., basal area, species composition, giant cane density ...).
- Conduct additional inventory of stands without adequate plot data from the 2008 forest inventory.
- Thin stands as needed to move mid-successional stands toward Desired Forest Conditions.
- Evaluate each stand for the presence and suitability of existing cavities. Retain cavity trees during thinning activities.
- Monitor thinned stands for exotic vegetation for a minimum of 18 months following harvest.
- Use small regeneration cuts (i.e., group selection) of usually 2-5 acres (no larger than 7 acres) if needed to improve oak regeneration.
- Continue conducting breeding bird point counts every 2-4 year (100 point counts/year) to assess changes in high priority bird occupancy. Stratify effort based on stand boundaries.
- Develop stand level continuous forest inventory (CFI) plots (25-50) distributed across the refuge as part of long-term monitoring. Utilize a 33-foot fixed radius plot as a means of examining tree composition, growth, recruitment, survivorship, mortality, and understory vegetation characteristics.

- Reevaluate wildlife-based DFC management strategy in 10 years based on avian monitoring, forest stand conditions, and priorities associated with resources of concern.

5.5 Hardwood Reforestation Management Strategies

5.5.1 Potential Strategies

From 1992 - 2000, approximately 1,300 acres of old agricultural fields throughout the refuge were reforested using bare root seedlings. Species planted included Nuttall oak, swamp chestnut oak, water oak, willow oak, cherrybark oak, green ash, bald cypress, sycamore, sweetgum, and cottonwood. Stands were planted on a 12' x 12' spacing (~300 saplings/acre). Many stands are old enough to be evaluated for survival, species composition, and density, all of which will be important in determining appropriate management actions. Several fallow fields have naturally regenerated into hardwood trees and three units (16, 32, and 35) have been identified for reforestation or natural succession.

Reforested stands advanced enough to support management action that meet any of the following conditions should be considered for some degree of timber stand improvement: overstory canopy >80%, midstory cover <20% or >50%, or tree stocking <50% or >90%, and/or basal area >90 ft²/acre. However, due to differential survival in the reforestation areas, many of the traditional silvicultural techniques may not apply to these stands, thus requiring professional judgment from Refuge Foresters to determine how to best proceed with stand improvement.

The most typical problem encountered in reforestation stands is the development of dense, even-aged stands, with very little species diversity and little to no herbaceous layer. In stands that are in this condition, possible strategies to counter this include thinning the stand and underplanting with additional species. Thinning can be accomplished either through mechanical or chemical methods. If mechanical methods are used, some degree of stump sprouting should occur, which would help in the formation of an uneven aged stand. Chemical methods would allow complete replacement of the treated tree which could presumably be replaced with a seedling of a different species, introducing diversity into the stand, as well as a new age class. If the stand is too dense, a heavy thinning or no underplanting would be recommended. Underplantings can be used to introduce additional species to the stand and can be accomplished either through the use of bare root seedlings or simply allowing natural succession to occur in openings that are created.

5.5.2 Management Strategy Prescription for Hardwood Reforestation

To meet Management **Objective 4.1.5** in all units where reforestation was done or natural regeneration has occurred, the following strategies will be done:

- Conduct a 10 factor prism or fixed radius plot inventory of each reforested unit once it reaches 20 years of age to determine species composition of all regeneration >6 inches DBH. Develop a GIS layer to include forest stand metrics.
- Inventory stands within 15 years of first assessment.
- Allow units 16, 32, and 35 to naturally regenerate to bottomland hardwood forest habitat. Supplement natural regeneration (i.e., green ash, sweetgum) with planted hard mast species (red and white oaks) on drier sites and cypress in wetter locations if necessary. A portion of Unit 16 is being maintained in early successional habitat for American woodcock and other wildlife. Mowing can continue in those portions of Unit 16 or it can be reforested to reduce edge and fragmentation on the landscape.
- Examine the potential to create roadside barriers of regeneration along Well Road and Neblett Road, which currently contain narrow strips of grass habitat.
- If oaks exceed 70% of the hardwood stem inventory, consider selective removal of oaks by either an application of trichlopyr in an oil carrier to the base of trees or hack and squirt with 10% imazapyr.
- For larger areas or areas with significantly more stems, the selective removal of trees would be done using tracked mechanical equipment for non-commercial purposes. Stems would be mulched or sheared and left on site.
- If failure of > 5 acres of reforestation occurred in a single location, consider direct root-stock replanting on a 12' x 12' grid with a mixture of site appropriate hardwood species.
- Control any invasive hardwoods (Chinaberry, privet) within stands using herbicide application.
- Conduct inventory and monitoring of breeding birds through point counts on a 2-4 year basis.

5.6 Breeding Wood Duck Strategies

5.6.1 Potential Strategies

The reliance on natural cavities for nesting by wood ducks is considered a limiting factor to local populations. The 80% loss of the forested conditions of the MAV has undoubtedly reduced southern wood duck breeding populations. The relatively young second growth forest of the Refuge constrains the potential for natural cavities for this species at this time. As a consequence, allowing the forest to continue to mature should benefit nesting cavity availability. As stands are thinned to meet desired forest conditions, trees that provide cavities or are forming cavities suitable for nesting should be left standing. In the interim, a lack of cavities can be readily overcome through an artificial wood duck nest box program. Central to this process is the provision of suitable brood rearing habitat within 1 mile of nest sites. Brood survival is higher in situations where nests are close to water. Many of the sloughs and temporary wetlands provide ideal brood rearing habitat early in spring.

For a nest box program to be successful, it requires that boxes are checked and cleaned on a regular basis and that every box is equipped with a predator guard. Currently, 25 boxes are in place on Dahomey NWR but some can only be accessed by ATV and require chest waders. Wood duck nest box programs typically are very time-intensive and these

boxes greatly increase the amount of time required to perform routine visits. Although the majority of the boxes are used, there is an extremely high incidence of dump nesting (more than one female laying eggs in the same box), along with a high incidence of nest predation, primarily snakes. As a result, the number of nest boxes should be reduced or relocated along the more accessible streams and sloughs. Monitoring might be possible through the Friends of Dahomey or students at Delta State University.

5.6.2 Management Strategies for Breeding Wood Ducks

To meet **Objective 4.1.3** for breeding wood ducks, the following strategies will be utilized:

- Evaluate the location of the existing wood duck nest boxes on the refuge and remove or relocate to improve access and monitoring capabilities.
- Clean boxes by February 1, repair doors and predator shields as necessary, and remove overhanging limbs to prevent predation by snakes and raccoons.
- Check boxes minimally once per year to document use; multiple checks during April, May, and June facilitates second and third broods being produced.
- Work with the Friends of Dahomey or Delta State University to volunteer to perform annual clean-out and monthly monitoring.
- Maintain water year-round as much as possible in units 46, 47, 48 and the slough in the northern portion of 45. (Most of this water is pooled as a result of beaver activity.) Pull off water if needed to prevent trees from dying.
- Promote growth of buttonbush throughout units mentioned above.
- Evaluate density of natural upper canopy potentially suitable for wood ducks in mature hardwoods

5.7 Pondberry Management Strategies

5.7.1 Potential Strategies

Presently pondberry is not known to occur on Dahomey NWR. A limited survey by Stewart (1991) indicated possible locations with suitable habitat. This endangered plant is known to occur in Bolivar County on a Conservation Easement held by the Service 15 miles north of the Refuge. However, strategies exist to support recovery efforts through survey of suitable habitat to locate possible extant pondberry colonies on the refuge, or as a location for experimental propagation and introduction. Efforts should focus on surveys initially and, if no colonies are located, work with the lead recovery biologist to evaluate introduction opportunities.

5.7.2 Management Strategy Prescription for Pondberry

To meet the objective of conserving or establishing pondberry colonies on Dahomey NWR, the following strategies will be undertaken:

- Identify suitable pondberry habitat on the refuge based on topographic relief and known wetland sites.

- Conduct systematic survey of suitable habitat during February through March to locate plant in flower. To optimize detection probability of pondberry, examine the colonies on the Conservation Easement north of the refuge to determine if the plant is in flower prior to surveys.
- If extant populations are identified, maintain current management practices around colonies to retain appropriate wetland conditions. and coordinate recovery efforts with lead biologist in the Jackson Ecological Services Office.
- If no pondberry colonies are identified, consult recovery biologist to evaluate potential for establishment of experimental populations through direct planting on refuge in areas with suitable habitat.

5.8 Land Acquisition and Management Strategies

5.8.1 *Potential Strategies*

Land acquisition after initial establishment of a refuge is a slow process. In most cases, funding is based on competitive resource priorities for all refuges established through the Land Acquisition Priority System (LAPS). Funds are then provided through the Migratory Bird Conservation Fund and/or the Land and Water Conservation Fund. As was the case for the establishment of Dahomey NWR, a third party, the Nature Conservancy, purchased the lands on behalf of the Service with repayment and fee title transfer done over a period of 3 years. Other possible strategies involve land swapping of FSA properties held in fee title for in-holdings or procurement and transfer of land to the Service for a wetland mitigation bank. The latter was done in 1991 by the Mississippi Department of Transportation (MDOT) providing 161 acres. It is also important to evaluate each new acquisition, determine what management capability is present, and determine how that acquisition can best be used to meet the goals and objectives of the Refuge.

5.8.2 *Management Strategy Prescriptions for Land Acquisition*

To meet **Objective 4.2.1** of acquiring and managing 2,110 acres of in-holdings for Dahomey NWR based on the HMP the following will be done:

- Maintain and update the current in-holdings within the LAPS for congressional funding through the Migratory Bird Conservation Fund and the Land and Water Conservation Fund.
- Work with MDOT, MS Dept. of Environmental Quality, Federal Highways and other state and federal agencies to establish potential mitigation banks within the acquisition boundary.
- Evaluate potential third party acquisitions and donations of in-holding properties.
- Consider current goals and objectives, as well as components lacking at a landscape level when evaluating management options for new landholdings.
- Allow a period of 2 – 3 growing seasons to evaluate the management capabilities of new landholdings, and then incorporate this acreage into the HMP.

5.9 Wild Pig Management Strategies

5.9.1 *Potential Strategies*

Wild pigs are a serious threat to all habitats they occupy. This invasive species compromises efforts to enhance or restore habitat and populations of trust resources. Though methods to fully eradicate free-ranging wild pigs have not been successful, focused efforts to control and significantly reduce localized populations are possible. Three primary strategies to deal with wild pigs consist of trapping, hunting, or capture with chase dogs (Hamrick et al. 2011). These strategies can be done singularly or in combination using both Service employees and the public. Trapping utilizing a variety of baited corral or individual steel traps can be done outside the public hunting season and target areas with high usage. An opportunity to allow the public to incidentally take pigs during other open game seasons provides a significant opportunity to reduce the population. Specialized hunt seasons for pigs have been shown to dramatically increase harvest at Dahomey NWR. These public hunts can include still hunting and/or pursuit with dogs to capture pigs. Success of any pig control program is dependent on recurring effort to prevent repopulation.

5.9.2 *Management Strategy Prescription for Wild Pig Control*

To meet objectives for all Resources of Concern across all Management Units, the following strategies will be done:

- Locate traps based on observed habitat destruction with emphasis near sloughs, bayous, other wetlands, and agricultural/moist-soil units.
- Trap during July-September when water availability will restrict pig movements.
- During all hunting season, allow and encourage the general public to harvest pigs.
- Utilize a specialized pig season in February where the public can still hunt or chase pigs with dogs. All pigs must be euthanized on site.
- During the post-harvest of cereal grains in October and November, use Service employees to night hunt agricultural fields for foraging pigs.
- Work cooperatively with adjacent landowners to control pigs through a trap lending program.
- Maintain records of harvest locations to evaluate effectiveness of control measures.

6.0 RESOLVING RESOURCES OF CONCERN CONFLICTS

Goals and objectives have been established through the Comprehensive Conservation Planning process. The broad goals were further defined as objectives regarding wildlife species or groups or the singular specific reference to ecological integrity of the habitat in the CCP. Most objectives were relatively vague and no prioritization scheme was established in the CCP. Through the HMP process, further refinement and clarification of Goals, Objectives and Strategies has been done with specific reference to the habitat(s) and anticipated response by Resources of Concern.

The challenge when implementing the Dahomey HMP is that objectives for habitats can have conflicting consequences among the Resources of Concern. Strategies to promote one may negatively affect others. Ideally, strategies would promote one resource of concern and have positive or no effect on the others. Such is not the case and the challenge is to minimize the conflicts among the Resources of Concerns or, when such conflict cannot be resolved or compromised, to prioritize the Resources of Concern.

Within the context of the Dahomey HMP for the next 15 years, 2 primary conflicts have been identified among the Resources of Concern along with the anticipated resolution of the issues.

Resource Conflicts:

- 1) Management for waterfowl through provision of agricultural/moist-soil habitat creates fragmentation on the landscape and limits the ability to achieve viable populations of forest interior birds and promote ecological integrity of bottomland hardwoods and,
- 2) Active management of bottomland hardwood forests to improve habitat for specific high priority interior forest birds (i.e. Swainson's warbler) and black bear is sometimes perceived to be in conflict with other bottomland hardwood forest species, such as for cavity dependent species (wood ducks, Rafinesque's big-eared bat, southeastern myotis and other cavity roosting and nesting species).

Resolution of Conflicts:

- 1) The establishing purposes for Dahomey NWR are based on the legal mandates of the Migratory Bird Conservation Act, and Emergency Wetlands Resource Act of 1986. The concept for establishing the refuge was based on land acquisition to meet goals of the North American Waterfowl Management Plan and, more specifically, foraging habitat objectives of wintering waterfowl set by the Lower Mississippi Joint Venture. The HMP recognizes these goals and objectives as the foundation for the establishment of the refuge. The existing agricultural/moist-soil units will continue to be managed intensively for waterfowl. It is recognized that the juxtaposition of the Units 5, 6, 9-12, 30, and 40 contributes significantly to forest fragmentation and prevents the

establishment of a Bird Conservation Area Core of ≥ 2000 acres (presently 560 acres). However, there are no alternatives to meet wintering waterfowl habitat objectives and this action must be a priority. If present in-holdings of the refuge are acquired, it may be possible to consolidate management efforts and thereby reduce fragmentation. In addition, should funding to hire additional personnel and equipment become available, Units 5 and 6 could be reforested and thereby reduce the conflict.

There is a debate among some biologists regarding active forest management and its implication to various wildlife species and the ecosystem under influence. Forest management practices that favor a suite of high priority migratory birds (e.g., Interior Forest Birds – Swainson’s Warbler – focal species) and black bear may seem to have impacts on other Resources of Concern (other interior forest birds, Rafinesque’s big-eared bats, southeastern myotis, pondberry) if there is a lack of proper planning. However, these conflicts are usually resolved by recognizing that most important cavity and den trees will be retained, especially along waterway buffers, and that bears along with many forest bats benefit from the same habitat conditions supporting the highest priority forest breeding birds in more diversified structure of treated stands, while other songbirds associated with more open midstory and understory remain relatively common long after stands have been treated. All forest management activities should attempt to minimize negative impacts to these Resources of Concern by having accurate stand data and selecting passively managed (control) areas, such as slough and river buffers, which hold the greatest potential for cavity roosting species and possibly pondberry.

The variable retention strategy used to achieve Desired Forest Conditions and improve habitat for forest interior birds, black bears, and other wildlife should be implemented in a way that minimizes conflict with other habitat needs. This will include the “choices” of individual trees to be removed, frequency of harvest, and tree characteristics including species, diameter, and age classes of trees to be removed. As mentioned in the bottomland hardwood strategies, care should be taken to retain cavity trees and other critical habitat features for other Resources of Concern.

Through the careful design of silvicultural treatments, selection of control areas, continued reforestation of agricultural lands, and improvement of reforested areas, Dahomey’s bottomland hardwood forest can gradually move toward providing Desired Forest Conditions for forest interior birds and other Resources of Concern.

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8.0 APPENDIX A

Appendix A. Common and scientific names of plants and animals referenced in the habitat management plan.

Common Name	Scientific Name
Plants	
Ash, Green	<i>Fraxinus pennsylvanica</i>
Bald Cypress	<i>Taxodium distichum</i>
Bitter Pecan (Water Hickory)	<i>Carya aquatica</i>
Browntop Millet	<i>Brachiaria ramosa</i>
Buttonbush	<i>Cephalanthus occidentalis</i>
Cocklebur	<i>Xanthium strumarium</i>
Coffeeweed	<i>Senna obtusifolia</i>
Elm, American	<i>Ulmus americana</i>
Eastern Cottonwood	<i>Populus deltoides</i>
Elm, Cedar	<i>Ulmus crassifolia</i>
Hickory, Shagbark	<i>Carya ovata</i>
Hickory, Water (Bitter Pecan)	<i>Carya aquatica</i>
Honey Locust	<i>Gleditsia triacanthos</i>
Japanese Millet	<i>Echinochloa crusgalli</i>
Oak, Cherrybark	<i>Quercus pagoda</i>
Oak, Nuttall	<i>Quercus nuttallii</i>
Oak, Overcup	<i>Quercus lyrata</i>
Oak, Swamp Chestnut	<i>Quercus michauxii</i>
Oak, Swamp Laurel	<i>Quercus laurifolia</i>
Oak, Water	<i>Quercus nigra</i>
Oak, Willow	<i>Quercus phellos</i>
Paw Paw	<i>Asimina triloba</i>
Poison Ivy	<i>Rhus radicans</i>
Peppervine	<i>Ampelopsis arborea</i>
Persimmon, Common	<i>Diospyros virginiana</i>
Pondberry	<i>Lindera melissifolia</i>
Sugarberry	<i>Celtis laevigata</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Water tupelo	<i>Nyssa aquatica</i>
Mammals	
Beaver	<i>Castor canadensis</i>
Black Bear	<i>Ursus americanus</i>

Common Name	Scientific Name
Nutria	<i>Myocaster coypus</i>
White-tailed Deer	<i>Odocoileus virginiana</i>
Wild Pig	<i>Sus scrofa</i>
Birds	
Acadian Flycatcher	<i>Empidonax virescens</i>
American Woodcock	<i>Scolopax minor</i>
Blue-winged Teal	<i>Anas discors</i>
Brown-headed Cowbird	<i>Molothrus ater</i>
Least Tern	<i>Sterna antillarum</i>
Mallard	<i>Anas platyrhynchos</i>
Northern Parula	<i>Parula americana</i>
Orchard Oriole	<i>Icterus spurius</i>
Painted Bunting	<i>Passerina ciris</i>
Pintail	<i>Anas acuta</i>
Rusty Blackbird	<i>Euphagus carolinus</i>
Swallow-tailed Kite	<i>Elanoides forficatus</i>
Vireo, Bell's	<i>Vireo bellii</i>
Vireo, White-eyed	<i>Vireo griseus</i>
Warbler, Cerulean	<i>Dendroica cerulea</i>
Warbler, Kentucky	<i>Oporornis formosus</i>
Warbler, Prothonotary	<i>Protonotaria citrea</i>
Warbler, Swainson's	<i>Protonotaria citrea</i>
Warbler, Worm-eating	<i>Helmitheros vermivorum</i>
Woodpecker, Red-headed	
Woodpecker, Ivory-billed	<i>Campephilus principalis</i>
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>
Wood Duck	<i>Aix sponsa</i>
Wood Thrush,	
Other	
Fat Pocketbook Mussel	<i>Potamilus capax</i>

9.0 APPENDIX B: ENVIRONMENTAL ACTION STATEMENT

U. S. FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ACTION STATEMENT FOR CATEGORICAL EXCLUSION

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action is categorically excluded from NEPA documentation requirements consistent with 40 CFR 1508.4, 516 DM 2.3A, 516 DM 2 Appendix 1, and 516 DM 6 Appendix 1.4.

Proposed Action and Alternatives. The proposed action is the approval and implementation of the Habitat Management Plan (HMP) for Dahomey National Wildlife Refuge (NWR). This plan is a step-down management plan providing specific guidance for implementing strategies to meet goals and objectives identified in the North Mississippi Refuges Complex Comprehensive Conservation Plan (CCP) (2005) which includes Dahomey NWR. There are no considered alternatives to the HMP given administrative requirement to complete this step-down plan.

The proposed CCP action was the preferred alternative (D) among alternatives considered in the Environmental Assessment (EA) (Draft CCP 2005). In the CCP, the proposed action was to manage the refuge provide high quality habitat for wildlife, particularly migratory birds (focus on waterfowl). Management would focus on waterfowl through a continuation of cooperative farming, force-account farming, and moist-soil management to meet established wintering waterfowl foraging habitat goals of the Lower Mississippi River Valley Joint Venture

The CCP has defined goals, objectives and strategies to achieve the stated action. The actions further detailed in the HMP have been identified, addressed, and authorized by the North Mississippi Refuges Complex CCP and accompanying Environmental Assessment (U.S. Fish and Wildlife Service 2005). These include:

- Agricultural/moist-soil Management Strategy: Utilize a cooperative farm program to grow high energy cereal grains and/or moist-soil management for native vegetation to provided needed foods for migrating and wintering waterfowl according to CCP Goals 1 and 4 (Objectives 1-1, 4-1).
- Green-tree Reservoir Management Strategy: Provide flooded bottomland hardwood during the dormant period to support wintering waterfowl CCP Goal 1 and 4 (Objectives 1-1, 1-2, 4-2).
- Forest Wetland Protection and Restoration Strategies: Identify and implement a process to restore or enhance the natural hydrology of the forested area to benefit the ecological integrity of the system and the wildlife resources that depend on the habitats. CCP Goal 2 and 4 (Objectives 2-2, 4-2,

- Bottomland Hardwood Forest Management Strategy: Manage the forested areas on the refuge for the collective benefit of resources of concern that promotes the ecological integrity of the system. For the duration of the HMP bottomland forest will be managed and resources of concern inventoried and monitored CCP Goal 1, 2 3, and 4.
- Reforestation of Management Strategy: A program to promote natural or direct reforestation of previous agricultural fields on the refuge and if desired a means to alter the species composition through herbicide or non-commercial removal CCP Goal 4 (Objective 4-2)
- Pondberry Management Strategy: Identify occurrence of pondberry on the refuge or implement recovery actions to introduce the plant to suitable wetland locations to CCP Goal 3 (context of Objective 3-1 though not named specifically)
- Wild Pig Management Strategy: Control/eradicate wild pigs to promote the ecological integrity of the bottomland hardwood forests according to CCP Goal 4 (Objectives 4-2, 4-3)
- Land Acquisition and Management Strategy: Develop a program to secure the balance of lands within the approved acquisition boundary and determine habitat management capabilities according to CCP Goal 5 (Objective 5-1)

Categorical Exclusion(s). Categorical Exclusion Department Manual 516 DM 6, Appendix 1 Section 1.4 B (10), which states “*the issuance of new or revised site, unit, or activity-specific management plans for public use, land use, or other management activities when only minor changes are planned. Examples could include an amended public use plan or fire management plan.*”, is applicable to implementation to the proposed action.

Consistent with Categorical Exclusion (516 DM 6, Appendix 1 Section 1.4 B (10)) the HMP is a step-down management plan which provides guidance for implementation of the general goals, objectives, and strategies established in the CCP, serving to further refine those components of the CPP specific to habitat management. This HMP does not trigger an Exception to the Categorical Exclusions listed in 516 DM 2 Appendix 2.

Minor changes or refinements to the CCP in this activity-specific management plan include:

- Habitat management goals and objectives are restated so as to provide improved clarity in the context of the HMP.
- Habitat management objectives are further refined by providing numerical parameter values that more clearly define the originating objective statement.

- Specific habitat management guidance, strategies, and implementation schedules to meet the CCP goals and objectives are included (e.g. location, timing, frequency, and intensity of application).
- All details are consistent with the CCP and serve to provide the level of detail necessary to guide the refuge supporting the resources of concern and goals and objectives.

Permits/Approvals. Endangered Species Act, Intra-Service Section 7 Consultation was conducted during the CCP process. The determination was a concurrence that the CCP is not likely to adversely affect the bald eagle or interior least tern (signed October 12, 2004 within CCP). Consultation did not consider the potential occurrence of pondberry or fat pocketbook mussel. Pondberry could exist on the refuge; the fat pocketbook mussel is restricted to the larger tributaries of the Mississippi River and suitable habitat does not occur within the refuge.

Public Involvement/Interagency Coordination. The proposed HMP is a step-down of the approved CCP for North Mississippi Refuges Complex (Dahomey NWR was included in a combined CCP representing all refuges under the Complex). The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was developed as part of the draft CCP which proposed and addressed management alternatives and environmental consequences before final approval of the selected alternative (D) by the Service for the CCP.

Public involvement included public notification in the local Grenada and Cleveland, MS newspapers for the public review (30-day availability) of the draft CCP. In addition, 2 public meetings were held (no attendance). Written comments were received by four individuals including 1 private citizen, 1 state agency, 1 federal agency, and a Mississippi State University professor. Comments were supportive of the preferred alternative (D) and included in the final CCP document.

Supporting Documents. Documents for this determination include relevant office file material and the following key references:

U.S. Fish and Wildlife Service. 2005. North Mississippi National Wildlife Refuges Complex, Draft Comprehensive Conservation Plan and Environmental Assessment. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA

U.S. Fish and Wildlife Service. 2005. North Mississippi Refuges Complex Comprehensive Conservation Plan and for, Grenada, MS. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA

Elizabeth Schmitt 11/14/13
Refuge Supervisor Date

Schmitt 11/14/13
for Project Leader Date

Richard Warner 11/08/2013
Regional Refuge NEPA Coordinator Date